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FURTHER OBSERVATIONS ON THE USE OF THE SATURATION METHOD OF RADIATION THERAPY IN DEEP-SEATED MALIGNANT DISEASE, WITH SOME STATISTICS[1]

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AT the First International Congress on Radiology, London, 1925, one of us (1) described the Saturation Method of Radiation Therapy as Applied to Deep-seated Malignant Disease. Since then the method has been in use extensively in the United States and to a considerable extent in some other countries. Further observation may, therefore, be of some interest.

It has come to our attention that in a number of instances the general principles have not been clearly understood. "Saturation" indicates the greatest amount of radiation that can be tolerated by the surrounding normal tissues without damage being done to them. The "Saturation Method" depends upon the delivery into the diseased area of what we have learned to term an "erythema dose," or "toleration dose," and then the retention of this effect for a certain time by additional smaller doses of radiation at intervals to correspond to the loss in effect during any period. The rate of loss and the amount of radiation to be given at any interval is indicated by a series of curves which were published three years ago and which we have found no reason to change. The method was previously described in a preliminary report by Kingery (2), as applied to skin diseases, in 1920. The curve presented by him applied only to surface effects and to unfiltered radiation. The principles involved in his communication can also be applied to deep-seated malignant disease and to various degrees of filtration.

HOW THE CURVES ARE DETERMINED

The formation of these curves depends primarily upon clinical observations. Clinical observations often precede experimental proof. Quinine was used to cure malaria before the malarial parasite was discovered, and mercury was used in the treatment of syphilis before the spirochete of syphilis was found.

It has been observed by all of us that the tissues recover after a time from the effects of a maximum toleration dose of radiation, and at the end of such a period the radiation may be repeated. This rate of recovery must obey some definite law. Kingery as-

[1]Presented before the Second International Congress on Radiology, in Stockholm, Sweden, July 22–27, 1928.

sumed that it obeyed the law of "mass reactions." The rate of loss of effect and recovery should represent a logarithmic curve, and it has been so calculated. Such curves have been established for many chemical and biological reactions. During these eight years, we have found such curves to work practically.

According to the above law, the rate of recovery is more rapid when the effect is the more intense, up to the limit of normal tissue toleration. Therefore, when the interval in days is known for the recovery of the tissues from the effects of any given type of radiation, the curve can be established.

In 1905, we first recommended the use of a filter, based upon Walter's[2] work. The filter recommended at that time was one of sole leather. This was soon replaced by the use of one or more millimeters of aluminum. We all observed that this increased the amount of radiation that could be given before an erythema dose was reached, but that the interval for repetition must be increased. This interval must be prolonged in proportion to the amount of filter and voltage used. For unfiltered roentgen rays, 100 K.V. (18 cm. spark gap), the interval is 14 days. For 130 K.V. (23 cm. spark gap) and 2 mm. aluminum filter, it is 21 days. For 130 K.V. (23 cm. spark gap) and 6 mm. aluminum filter, the interval is 28 days. For 200 K.V. and 0.5 mm. copper and 1 mm. aluminum filter the interval is 8 weeks. Therefore, a curve must be arranged to correspond to each type of radiation used. We have not been able definitely to determine this interval for gamma radiation, but the interval is surely longer than with any other type of radiation. When using the gamma rays from radium, or a combination of gamma rays and high voltage roentgen rays, we have followed the principle of prolonged radiation, being careful not to exceed the total allowable for each type.

In preparing and applying these curves, therefore, it is assumed, and it has been found practical, that, when the interval is divided into days, if a maximum toleration dose (100 per cent) is given, a 50 per cent dose can be added after an interval of one-fourth of this total recovery time (2 weeks), and 75 per cent after one-half of the total time (4 weeks). For example, in the use of the soft unfiltered rays, an erythema dose can be followed by a 50 per cent E.S.D. after an interval of 3½ days, or 75 per cent after one week.

It must not be assumed that such small doses can be kept up indefinitely or even that the saturation process can be continued indefinitely or very long. This is the great danger of this method. One must always keep in mind the atrophy, endarteritis, and the late degenerative processes, or even early necrosis, which are likely to follow overdosage. On the other hand, if the radiation is kept at the saturation point (or as nearly so as the normal tissues will permit) during the brief period of sensitivity of the malignant cells, and while these cells are still undergoing division, it is likely that the disease can be more completely destroyed. At least, this is the writers' opinion.

The curves accompanying this paper apply to the different types of radiation (Figs. 1, 2, 3, 4, 5).

PRACTICAL APPLICATION OF THESE CURVES

The successful application of this method requires that—

(1) An accurate diagnosis must be made as to the nature and the extent of the malignant disease: also its relation to essential organs which must be protected.

(2) There must be a careful measurement and record of the quality of radiation which is used.

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[2]Walter: Fortschr. a. d. Geb. d. Röntgenstrahlen, VIII, 297.

(3) The superficial and the depth doses must be determined. This matter must be taken into account and recorded at each treatment.

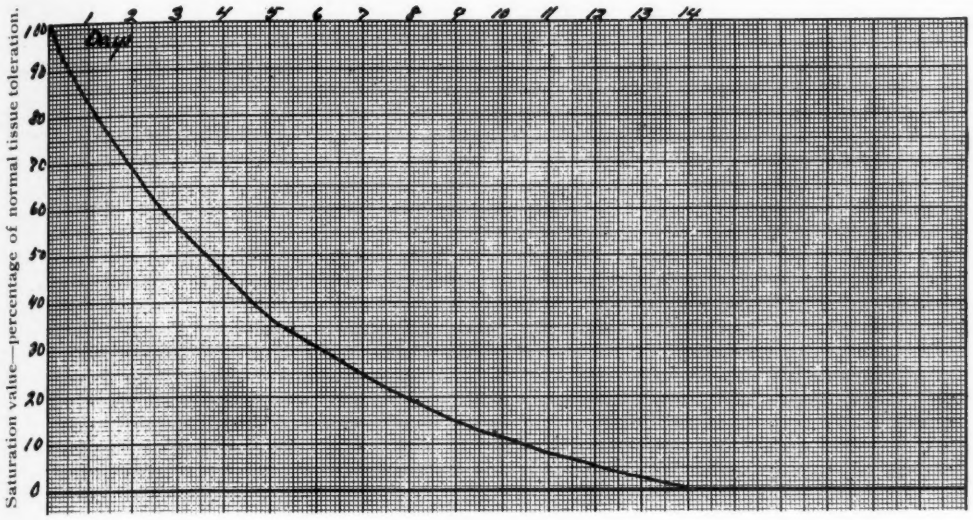

Fig. 1. Saturation curve for use with unfiltered rays, using from 18 cm. parallel spark gap, for superficial skin effects. Determined upon the basis of a repetition of a full erythema dose in approximately fourteen days (0.35 Å. U. mean wave length).

(4) Usually multiple portals of entry must be used. In cross-firing from various portals of entry, the beam of rays must be carefully directed so that no excessive dosage will be obtained at any one point, as emphasized especially by Holfelder (4). This is especially important when treating through a mass of fat, such as in a thick abdominal wall. One should aim to get the maximum effect on the diseased tissue and the minimum on essential organs.

(5) The curves apply to both the surface and depth effects in proportion to the intensity at each point, and the saturation value must be estimated both at the surface and the depth at each dose. This will seem complicated, but it becomes a simple matter by practice.

(6) Daily applications over one portal, applied serially or successively, give the best results, and it is our opinion that applications twice daily would be even better, because that method would approach more nearly continuous radiation such as is obtained from the use of radium. This multiplication of treatments, however, involves increased cost.

(7) One should aim to build up the 100 per cent or maximum normal tissue toleration dose in the tumor area as rapidly as is practical, so as to destroy the disease while it is sensitive to the radiation, and then continue the effect for a time.

(8) The total amount of radiation must be recorded, for it is this total which gives the late degenerative effect in the normal tissues. The toleration of normal tissues depends chiefly upon the vascularity, or amount of blood supply. The subcutaneous fat is in particular poorly supplied with blood, and is especially prone to degenerative changes. We realize that when we pass 200 per cent of total radiation over fatty tissue we are taking some risk. The larger

the field of radiation, the greater the danger. In a small field, well supplied with blood, one can give as much as 400 per cent or even 500 per cent, depending upon the size and locality.

(9) As a practical example, let us assume a typical tumor, located in the center of the body, 20 cm. in diameter, which can be treated through four portals of entry. Let us then assume that we are using high voltage rays which give a value of 36 per cent at 10 cm. depth. If we give 75 per cent through each of the four portals successively on 4 days and refer to the curve as shown in Figure 4, we will see that we have in the tumor area on each successive day, 27 per cent, 53 per cent, 78 per cent, and 100 per cent, respectively. Then on the sixth day one may add 7 per cent on the tumor area (19 per cent on portal No. 1), or, if one at this stage allows a 2-day interval, the dosage to be added on the tumor area will be 12 per cent and on the surface 34 per cent. It is essential, in this or any other method treating deep-seated malignant disease, to keep constant record of the surface and depth value of the radiation.

The advantages and disadvantages of the Saturation Method were discussed three years ago, but they are principally:

(1) An improvement in results, chiefly due to the prolongation of the radiation effect.

(2) The avoidance usually of constitutional effects.

(3) The avoidance of damaging effects on the tissues.

RESULTS OF TREATMENT

Time and space will not permit a detailed review of the statistical results, and only a brief summary can be given, for unless a most careful and detailed classification is made the conclusions are of little more value than a personal impression. Likewise, no statistics can be judged fairly unless they are

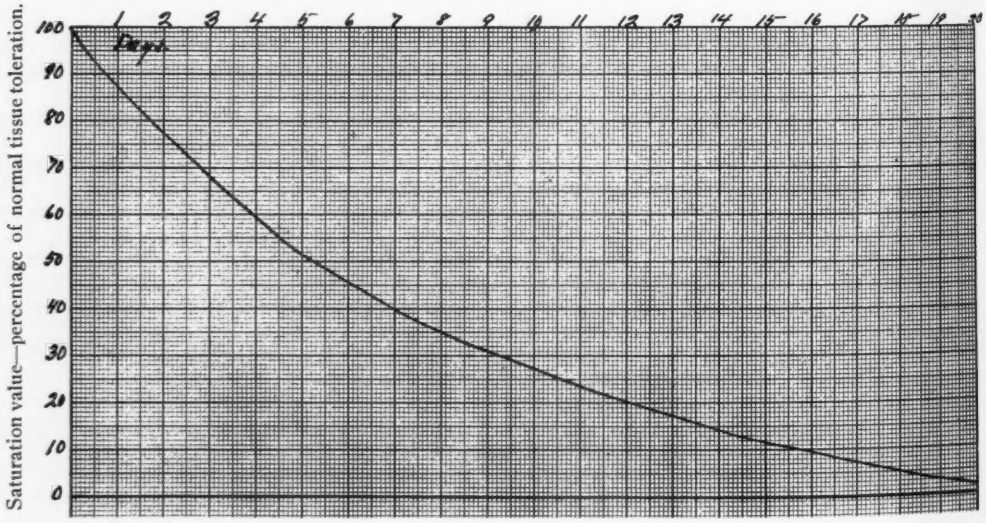

Fig. 2. Saturation curve for moderately soft rays, using a potential equal to 22 cm. parallel spark gap, 2 mm. of aluminum filter, based upon a time interval of three weeks.

compared in like detail with those collected by other authors.

CARCINOMA OF THE LIP

We have had experience by various methods of radiation treatment with 463 cases of cancer of the mouth. Of these, there were 138 cases of *cancer of the lip.* The patients numbered 122 males and 16 females. Among these, as they were referred to us, there were 11 cases of recurrences following the use of caustic pastes. There were 46 cases with recurrences following surgical excision—27 were local recurrences only and 19 were local plus glandular metastasis.

Of the 138 cases of lip cancer, as they were referred to us, 82 (or 59 per cent) were primary without glands. Of this group of 82 primary cases, 80 cases (or 97.5 per cent) were clinically cured. Of these cured cases, 32 (or 40 per cent) have passed the five-year period. The others have passed only the 3-year period. *It is our experience, however, that the very great danger of recurrence is during the first six months,* and all recurrent cases that have been referred to us developed their recurrences within the first six months. Since the use of the saturation method, we have had no failures in the primary cases, without metastasis.

There were *10 primary cases* referred to us with *glandular metastasis.* Four of this group had advanced inoperable local lesions, and 2 of these 4 are still living and free from disease, 6 and 7 years, respectively. Of the 6 remaining cases, 5 were free from disease for 3 years; then 2 patients died of intercurrent disease; 3 are living 6½, 7, and 7 years, respectively, and the other case could not be traced after the first year. Of these 10 cases, with palpable lymph nodes, 8 were treated by the saturation method.

In the group of 27 cases, referred with local recurrences, and with questionable glandular involvement, 19 (or 70 per cent)

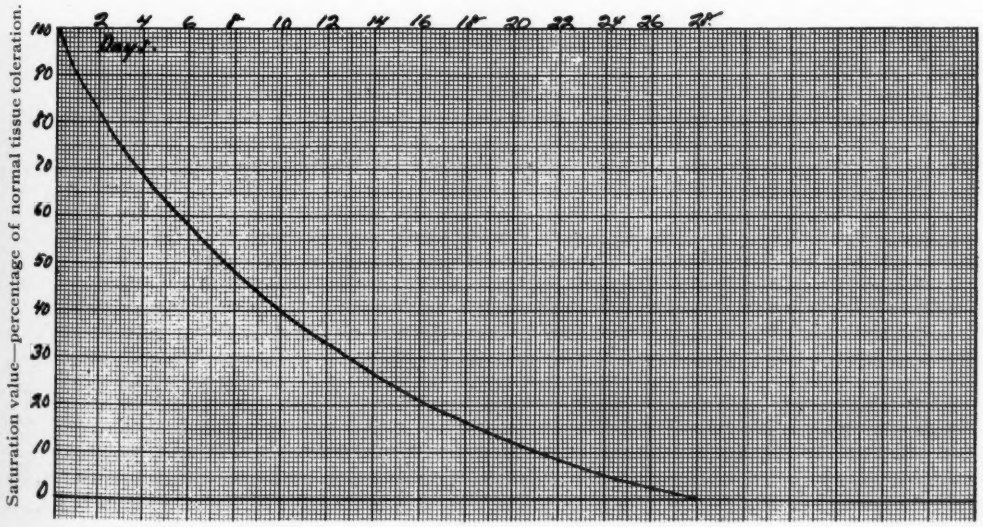

Fig. 3. Saturation curve for use with moderately hard rays, using a potential equal to a 9-inch (23 cm.) parallel spark gap, 6 mm. aluminum filter, giving rays having a mean wave length of approximately 0.23 Å. U. Based upon a repetition interval of four weeks.

recovered clinically; 14 (or 74 per cent) of these 19 cases remained well from 3 to 13 years, with an average duration of 4 years. Five of these 19 cases were not traceable after ½, ½, 1, 2, and 2 years, respectively. Of this group of 27 local recurrences, 18 received treatment according to the saturation method.

In the third group of 19 recurrent cases with advanced local and metastatic disease, 1 case (or less than 5 per cent) recovered and has remained well for 7½ years. This case was treated by the saturation method. In the other 18 cases, the duration of life was less than 1 year.

In the routine treatment of primary carcinoma of the lip, the local disease is destroyed by electrocoagulation, excepting when the disease is so extensive that the sacrifice of tissue would be too great. In these cases, radium is used. In none of our primary cases was there a bloc dissection of the lymphatic glands. Instead of this surgical procedure, the chin and lip and the adjacent lymphatics are treated by highly filtered radiation to the point of saturation, which treatment is kept up for two weeks. When metastatic lymph nodes are resistant to surface radiation, radium element in iridio-platinum needles is inserted for about half the time necessary to produce necrosis.

TONGUE CARCINOMA

Carcinoma of the tongue has proven itself one of the most vulnerable and difficult types of disease with which to deal. Treatment by surgery alone has for various reasons proven inadequate and unsatisfactory. The early records of most investigators show a high percentage of inoperable cases. In Quick's cases only 27 per cent were operable at the time of applying for treatment. Judd (5) found only 40 per cent of the cases at the Mayo Clinic operable. At the Massachusetts General Hospital the operability was 65 per cent. At the Collis P. Huntington Memorial Hospital only 19 per cent of 103 cases were suitable for operation. At the Huntington Hospital

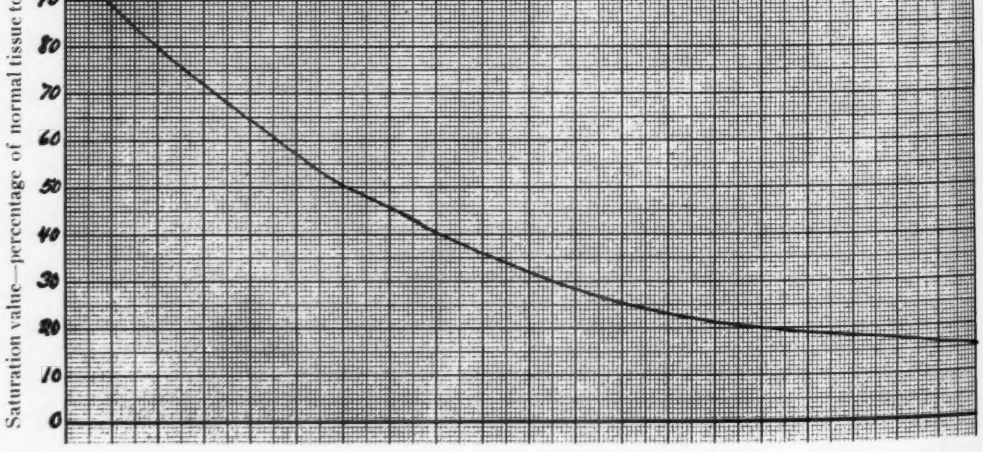

Fig. 4. Saturation curve for use with hard rays having a mean wave length of approximately 0.165 A. U. (200 K.V. — 0.5 Cu., 2 Al.) and based upon the interval between two full erythema doses of a period of eight weeks.

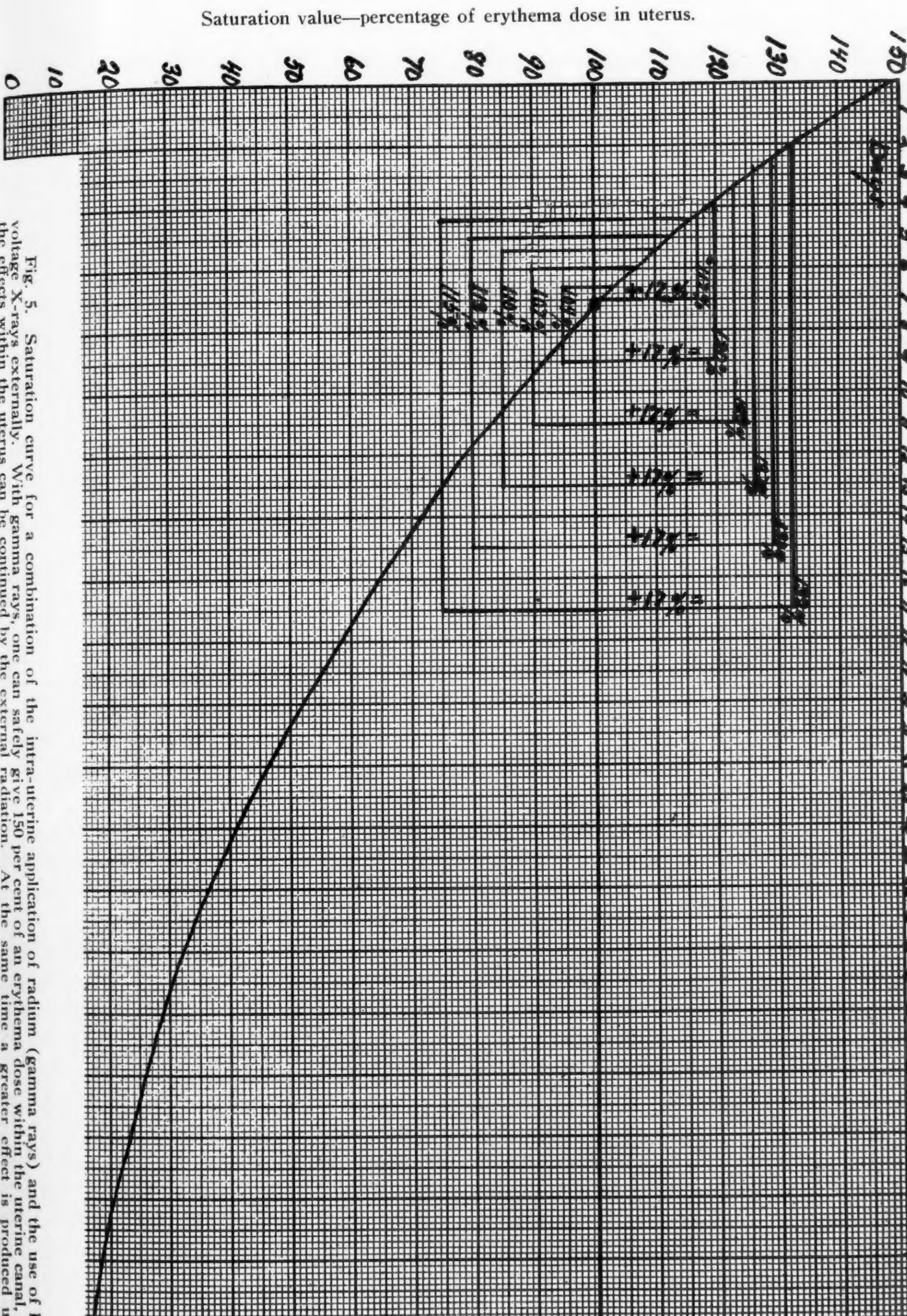

Fig. 5. Saturation curve for a combination of the intra-uterine application of radium (gamma rays) and the use of high voltage X-rays externally. With gamma rays, one can safely give 150 per cent of an erythema dose within the uterine canal, and the effects within the uterus can be continued by the external radiation. At the same time a greater effect is produced upon metastasis in the pelvis. The 17 per cent X-ray depth dose, seventh day, is based upon a 34 per cent depth dose at 19 cm. and a 50 per cent surface dose on one of three portals of entry, on alternate days, or half this quantity daily.

(1918-1920) 40 per cent of 379 cases were operable.

In the operable group, surgical statistics vary to a considerable extent. Meller (6) found that operation prolonged life 13.4 months, cured 14.6 per cent, and had a mortality of 13 per cent. Morestin (7) placed the operative mortality at 20 to 25 per cent. Capette (8) analyzed 777 cases and reported 17 per cent free from disease over three years. Simmons (9), in 26 operable cases, reports 12.5 per cent clinically cured.

Schreiner (10), in an analysis of the radiation treatment of 127 tongue cancers, records 50 cases without gland involvement in which 16 (or 34 per cent) were clinically well. In 77 cases with gland involvement, only one is clinically well. The longest palliative result was 2 years and 10 months. At the Curie Institute, Régaud (11) analyzed 174 of 186 cases of radiation treatment of carcinoma of the tongue. There were 42 (or 24.1 per cent) clinically well from 1 to 5 years. Of this group of 42 cases, 14 (or 34.3 per cent) were borderline operable cases and 5 were inoperable. Menegaux (12) compares the results in 78 patients operated on in the service of Prof. Lenormant with those in 91 patients subjected to radiotherapy in Proust's clinic. Surgical removal of the lesion, combined with the removal of lymph glands on the same side, gave a mortality of 15.7 per cent, 74 per cent of failures, and 10 per cent of cures. When the operation was combined with the removal of lymph glands on both sides, the mortality was 33.3 per cent, 52 per cent of the cases resulted in failure and 14 per cent in cure. When the surgical treatment was combined with radium therapy, the results were: mortality 35.5 per cent; failures 46.5 per cent; cures 20 per cent. When radium therapy alone was employed, there was no mortality, 66.5 per cent of failures and 33.5 per cent of cures. Surgical removal of the lymph glands associated with intralingual use of radium had a high mortality and resulted in less than 20 per cent of apparent cures.

Of Quick's (13) series of 148 cases, 69 (or 45.8 per cent) were primary without glands, but only 34 (or 23 per cent) were operable. Of this number (34 cases), 29 (or 85.3 per cent) are clinically free from disease for periods of from 2 months to over 3 years. Most of these cases were treated by the insertion of radium emanation tubes. In the total series of cases, including gland involvement, 43 (or 29 per cent) are clinically free from disease. Forssell (14) reports clinical 3-year cures in 22 cases (or 71 per cent) at the Radiumhemmet (31 cases).

STATISTICS OF TREATED CASES OF CARCINOMA OF THE TONGUE

In our own series of 132 cases, 23 were not treated because they were too far advanced, leaving 109 that were classified. Fourteen cases were females.

There are 27 cases in the primary group with no glands. Twenty-three (or 85.2 per cent) are clinically well. Fifteen cases (55 per cent) are living from 4 to 15 years after treatment. Twelve are free of disease 6 months to 4 years after treatment.

There are 33 primary cases with glands. Of these, 12 (or 40 per cent) are clinically well from 1 to 5 years after treatment. One patient died of intercurrent disease; 5 cases are not traceable. Fifteen patients dead, with an average life of 1½ years after treatment.

There were 33 primary inoperable cases with glands. Eleven cases are not traceable; the other 22 patients died from 6 months to 3 years after treatment.

There were 16 inoperable recurrent cases with metastasis. One patient is still living (2 years); one patient died from intercurrent disease after 3 years; 9 cases are not trace-

able; 5 patients dead after an average life of 2 years after treatment.

Of all tongue cases coming under our care, 23.6 per cent are cured. This, of course, includes the advanced inoperable and the advanced recurrent cases with metastasis. Of the primary cases with no glands, treated by the Saturation Method since 1920, 89.4 per cent are clinically cured, as compared with 77 per cent of clinical cures before beginning our saturation technic. In the primary group with glands, 90 per cent are clinically cured with the saturation technic as compared with 33 per cent of clinical cures before beginning the saturation technic.

REMARKS

In the advanced recurrent group with metastasis to the deep cervical nodes, palliative treatment is the most that can be expected. Electrocoagulation has been successful in the treatment of small lesions on the anterior half of the tongue. We cannot recommend it for the deep infiltrating ulcerating carcinomas of the tongue, nor even small lesions on the posterior aspect. Insertion of radium element in platinum iridium needles, after Régaud's method, has shown promising results. In every case, heavily filtered surface radiation has been used, both locally and on the regional glands, whether palpably enlarged or not. Sloughing of tissue, whether by radium implantation or by electrocoagulation, is avoided when possible. The associated infections from such wounds not only cause much suffering and distress, but may be a factor in rendering rapid dissemination and even promote the progress of the disease. Our aim now is to deliver the greatest intensity of surface radiation, highly filtered, and, in favorable instances, when regression seems protracted, supplement interstitial radiation, in the platinum iridium filtration 0.5 mm., attempting to keep the intensity within a range of 50 per cent of what we have learned from experience will produce a slough.

CARCINOMA OF THE BREAST: STATISTICAL ANALYSIS OF RADIATION TREATMENT

An analysis of 801 cases, up to 1922, shows 590 cases available for 3- and 5-year statistics. Of all the cases treated, 50 per cent were living at the end of 3 years, and 27 per cent at the end of 5 years.

Of the early operable cases with no glands, 86 per cent were alive at the end of 3 years, and 68 per cent were alive at the end of 5 years.

Of the late operable cases with glands, 68 per cent were alive at the end of 3 years, and 46 per cent were alive at the end of 5 years.

The recurrent operable cases show 69 per cent alive for 3 years, and 54 per cent alive for 5 years.

The advanced recurrent and metastatic cases, including the primary inoperable cases, show 40 per cent alive for 3 years, and 16 per cent alive for 5 years.

Up to the present time (1928), 1,066 private breast cases have been treated by radiation in the service of one of us (G. E. P.) and 3- and 5-year results in 212 more cases have been estimated, bringing the total 5-year values up to 802 cases. This last group of cases received treatment according to the saturation technic, and show an improvement of 53.9 per cent alive for 3 years, and 31 per cent alive for 5 years, including all types of cases, operable, inoperable, and recurrent, as compared with 50 per cent for 3 years and 27 per cent for 5 years before the saturation technic. The duration of time is still too short to make a proper evaluation of the final end-results on cases receiving Saturation Method, but this improvement is encouraging.

Since beginning saturation, 68 per cent are alive for 3 years, and 57 per cent are alive for 5 years, in the group of cases classed as operable. Some of these patients received pre- and post-operative and others post-operative treatment alone.

The average in 32 large surgical clinics shows the percentage of curability of operable cases by surgery alone to be approximately 38.6 per cent for 3 years and 28.8 per cent for 5 years.

It is of interest to know that in more than a thousand cases referred to us for radiation therapy, 37 per cent belong to the operable group, including early and late cases, *and 67 per cent are advanced recurrent cases or advanced inoperable cases.* In other words, 67 per cent of 714 cases must either be abandoned, or be given the benefit of intensive and thorough radiation treatment. This large group of cases (67 per cent), therefore, are never comparable to any of the usual surgical statistics or groupings in which operation has been possible.

SUMMARY AND CONCLUSIONS

The Saturation Method of radiotherapy aims at a maximum, prolonged, and continuous radiation effect in the tumor area to the limit of normal tissue toleration.

The object is to give sufficient radiation to destroy the tumor cells during the stage of division and to continue this effect long enough to destroy all of the cells as they divide. It has been found, generally, safe to continue this effect, according to the curves which have been published, during a period of from two to three weeks.

A review of 463 cases of carcinoma about the mouth and 1,000 cases of carcinoma of the breast seems to show an improvement as compared with other methods, in our experience.

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IODINIZED OIL IN THE DIAGNOSIS OF PREGNANCY[1]

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PREGNANCY, while a physiological condition, carries with it so many pathological potentialities that it is frequently essential for the proper diagnosis of a case and treatment of a patient to either confirm positively the presence of a pregnancy or eliminate it from the clinical picture, thereby avoiding unjustified interference, or, on the other hand, the overlooking of some serious condition on the theory that a pregnancy is responsible for the symptoms present.

Subjective and objective signs of pregnancy may fail to give us this information, and such sera tests as the Abderhalden may suggest pregnancy in the male or fail to confirm its presence in the known pregnant female; hence the continued search for a reliable diagnostic test and the welcome assured it by the often puzzled obstetrician.

Iodinized oil was first injected into the uterus as a diagnostic aid to determine the presence of pregnancy by C. Heuser (1), who claimed that X-ray films were conclusive when one or two months had passed since the last menstrual period. He also claimed that the method was safe so far as interference with the continuation of pregnancy, when present, and in many cases, where abortion was to be desired on account of an active pulmonary tuberculosis, the patient continued her pregnancy until more radical methods were employed.

It was with some hesitation that we began a confirmatory study of lipiodol injections in the pregnant uterus, on account of our fear of interrupting an existing pregnancy and the even greater fear of a maternal fatality in case streptococci or other infectious organisms existed in the birth canal of the patient examined.

Fig. 1. Shows the fetus occupying the uppermost part of the uterine cavity and lipiodol the lower part.

The literature reports streptococci in the vaginas of 40 per cent of all pregnant women, 4 per cent of which are hemolytic. Our previous study of the problem has proved confirmative, with the exception that we have thus far been unable to cultivate streptococci from a non-eroded cervix, and, in cases where streptococci were present in the erosion, they gave negative cultures after a thorough cauterization and complete healing of the wound. We therefore selected with care the cases to be examined, eliminating the erosions and cases in which, for any reason, we had reason to fear a miscarriage.

A bivalve speculum was inserted in the vagina, bringing the cervix into view. This

[1]Read by Dr. Martinez before the Radiological Society of North America, at the Thirteenth Annual Meeting, at New Orleans, Dec. 1, 1927.

Fig. 2. Shows the lipiodol on the left side of the uterine cavity and the fetus on the right.

Fig. 4. Case of double uterus. Pregnancy in right uterus, 7 months; head of fetus is seen; lipiodol in left uterine cavity.

we wiped free of all mucus and painted with a 5 per cent solution of mercurochrome. The Ultzman-Keyes nozzle was gently introduced 1½ cm., up to the rubber tip, which was held by slight pressure to prevent the return flow of the solution (we especially avoided the use of a tenaculum forceps for fear of producing unnecessary irritation); then 5 to 10 c.c. of lipiodol was slowly introduced into the uterine cavity and an X-ray film taken.

Fig. 3. Shows a gravid uterus (upper part); lipiodol on the left.

In the non-pregnant normal uterus a triangular cavity can be demonstrated, and, in addition, if the tubes are open, the lipiodol follows to the end of the tube, showing a free flow into the abdominal cavity. This flow either takes place immediately or, at times, may be delayed and appear some hours later. If one or both tubes are closed, the lipiodol will show the point of closure or perhaps some diverticula—a recently advanced cause of tubal pregnancy—if such a condition exists. (So far we have not had a case suggesting diverticula.)

In the gravid uterus the lipiodol shows as an irregular mass filling that part of the uterus unoccupied by the conception, which bulges toward the center of the cavity, giv-

ing a very clear picture of its point of attachment—whether at the top or at one side.

We have used this method for the early diagnosis of pregnancy in fifteen cases, none of which gave signs of threatened abortion before the test. A positive diagnosis of pregnancy was made in every instance. With this small series we stopped the use of this procedure because three of the cases aborted—three, four, and five days, respectively, after the injection.

In consequence of this experience we believe the lipiodol and roentgen-ray examination to be dangerous and unjustified, and, much as we regret giving up what we consider as the most positive diagnostic method of early pregnancy, still, if our experience of 20 per cent abortions in examined cases can be considered as even approximating the danger, it would surely outweigh the disadvantages of waiting. After the interval of a month or two the diagnosis can be made in a manner which entirely avoids the danger of a miscarriage.

CONCLUSIONS

1. Before lipiodol injections are made the cervix must be healed, and, if tubal trouble is suspected, all active inflammation must have subsided for months or even years.

2. The outlines of the uterine cavity and tubes are easily visualized by this method, and this is of great aid in eliminating the closure of the tubes as a cause of sterility.

3. The abortions which occurred in our series are sufficient cause to condemn lipiodol roentgenologic examination for the diagnosis of pregnancy.

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DISCUSSION

Dr. P. M. Hickey (Ann Arbor, Mich.): Dr. Martinez has said that he thought his paper was a failure. On the contrary, we must consider it a very important paper because it has put on record the possible danger of the employment of lipiodol in the diagnosis of pregnancy.

Dr. L. R. Sante (St. Louis): Dr. Martinez' paper was important from the standpoint of the danger, or possibility, of abortion in roentgen-lipiodol examination. This method has always seemed rather unusual and unnecessary, and now, after the study made by Dr. Martinez and Dr. Miller, I am convinced that it is undesirable. I do not see how, from the mere bulging of one side toward the center of the cavity, one is justified in concluding that a condition of pregnancy exists. Such a bulging might be produced not only by pregnancy but by a fibroid or a carcinoma. I think it is important to see the method tried in order to evaluate it.

Dr. H. P. Doub (Detroit): My feeling in regard to the paper by Dr. Miller and Dr. Martinez coincides with the discussion as given by Dr. Hickey.

PHYSIOTHERAPEUTICS OF DISEASES OF THE CARDIOVASCULAR SYSTEM[1]

By PROF. DR. FRANZ M. GROEDEL, BAD-NAUHEIM, GERMANY

AS late as the middle of the last century nothing was attempted except by medical measures in the treatment of disturbances of the circulation. Since then, physiotherapy has come steadily to the fore, and since the beginning of the present century it has been recognized as of equivalent value. Nowadays the majority of our heart cases are treated on physiotherapeutic as well as on medical lines.

Forms of Physiotherapy.—Nearly all the recognized forms of physiotherapy are used in the treatment of cardiovascular disease. Even with bed-ridden patients, massage is used in the form of gentle *effleurage,* or of friction with some aromatic substance. Obese heart patients need more vigorous manipulation. Even in the precordial pains of an anginal character, vibratory massage is occasionally effectual.

Medical gymnastics, both passive and active, are employed in several different ways, either manually or with the aid of special machines. Passive movements can be used even in cases of heart failure, but for active movements there must be a certain exercise-tolerance, and trunk movements should be given only if compensation is fairly adequate.

Heliotherapy is contra-indicated, but artificial sun baths are often of use, as they act as a stimulus to metabolism, and air baths are well tolerated, provided the air is warm and not stagnant.

The terrain-cure, first advocated by Oertel, necessitates a fairly good compensation, but climbing should be avoided as a rule, in heart patients.

Electrotherapy is used in various forms; the commonest is perhaps the four-cell or Schnee baths with a faradic current. The direct galvanic current has little or no place in treatment of disturbances of the circulation, but weak faradic baths are distinctly of use in functional and nervous conditions. These are also benefited by high frequency currents, applied either in the form of effluve or by d'Arsonval's method. Diathermy appears to act reflexly and is of distinct use in the relief of anginal pains. In the light of our present knowledge, the effect of X-rays is still obscure. Radiation of the aorta is said to relieve angina, and radiation of the suprarenals to lower blood pressure, but personally I have been unable to confirm these statements.

The most important branch of physiotherapy, so far as the cardiovascular system is concerned, is hydrotherapy. This can be applied either in the form of ice bags or cold water pipes, to calm and soothe a too forcible heart action, as in acute endocarditis and pericarditis, or as warm compresses over the precordium, or as hot foot and hand baths, which have a pain-soothing action.

Lastly, balneotherapy represents a most important means of treatment of many conditions, functional and organic, especially in early cases of failure of the circulation.

Cardiac Insufficiency.—In connecting cardiac insufficiency with balneotherapy, we must use the term in a much broader sense than that usually assigned to it clinically, for in true highly developed cardiac insufficiency any form of balneotherapy is strictly contra-indicated. Cardiac insufficiency, in the sense in which I use it here, means, rather, an inadequacy of the circulation, and here we must include various conditions usually grouped together under the heading of

[1]Read before the Thirteenth Annual Meeting of the Radiological Society of North America, at New Orleans, Nov. 29, 1927.

"functional disturbances." That again must be taken in a broader sense. If, for instance, a patient be suffering from a form of nervous or spastic angina pectoris, his pain is caused by a failure or insufficiency of the circulation, and it is really immaterial as to whether it be a spasm of a cardiac vessel, caused by an insufficient myocardial blood supply; an incompetence of the aortic valves, due to some displacement of the point of entrance of the coronaries, by the gaping valves, or whether, on the other hand, the basic condition be syphilitic changes in the wall of the aorta just where the coronaries are given off. But if we can thus widen our view of circulatory failure to include all these pathologic subjective and objective phenomena, then we must look on balneotherapy as an important therapeutic agent.

Historical.—Balneotherapy for circulatory disturbances had its birth at Nauheim, and is associated with the name of Beneke, who, in 1859, was the first to note that the carbon dioxide baths, then used only for the treatment of rheumatism, were not only well tolerated by patients with heart disease, but that their cardiac condition improved considerably while undergoing them. Twelve years later when Beneke published a hundred similar observations, reinforced by others made by Groedel I., Schott, and Joseph, balneotherapy came to its own as an important method of treatment in chronic heart disease.

The question so often asked by patients, as to how a bath can affect the heart—its connection with that organ being so remote—is quite comprehensible, when we consider that the only accepted theory that has attempted to solve this problem attributes the action of CO_2 baths to the gas which penetrates into the blood through the skin. I have opposed this theory for many years, and again I must point out that, inconsidering the circulatory apparatus, we are all apt to undervalue the importance of the skin as an organ.

Physiology of the Skin.—Physiotherapy, including baths, affects the body through the agency of the skin. We know a good deal about the physiology of the mucous membrane, and understand its importance as a resorptive organ, in our medical therapy, but the physiology of the skin, that far greater organ of resorption, is comparatively unknown. Up to now the skin has been regarded solely as a protective covering to the body; its importance as a heat regulator and a storage organ has been ignored. Even as a sensory organ it has received but scant recognition, and yet the skin, that is to say, the epidermis and the corium, is perhaps more richly supplied with nerves than any other region of the body. Skin has its own individual tactile sense, its own sense of temperature and pain. Its importance as an excretory organ is also much neglected. We know that the skin excretes water by evaporation, but the important part which it plays in gaseous exchange is generally overlooked. But if we stop to consider that, under normal conditions, 1½ per cent of the CO_2 given off from the body is excreted through the skin, and that this amounts to about 4½ liters per day at rest, and more on movement, we can well realize the importance of this function. On the other hand, the value of the skin as a receptory organ is often overrated. Its activity in this direction is really slight, and Tigerstedt holds that the skin's capacity for absorption for nearly all substances, solid, fluid, or gaseous, is extremely slight.

Lastly, there is an internal secretory function of the skin, and this is a fact which we must take into account. That the skin plays some large part in the system of internal secretions is evident from the fact that many internal secretory disturbances are shown in the skin. Furthermore, we know that pigment has a contracting effect

on the vessels, and, even if we cannot accept these two facts as proof-positive of the internal secretory function of the skin, we must recognize the skin's extraordinary importance as the receptory organ for all stimuli for internal secretion and metabolism. Let me recall to your memory F. Müller's work on the fall in the leukocyte count after even the smallest intra-cutaneous injection. If we survey all this evidence regarding the importance of the skin as an independent organ, we can understand how important may be the effect of baths on the nerve-endings in the skin. Another point hitherto much neglected is the extensive capillary system of the skin.

Mechanics of the Circulation.—When we speak of the mechanical work of the circulatory apparatus, it is always described as a double pump, which drives the arterial blood through the body, collects the venous blood and drives it back through the lungs, arterialized, to the heart. Also, we are told that by this forward movement of blood in the vessels, and by virtue of the latters' stored up elastic power, the periodic and rhythmic power of the heart beat is transformed into an equalized propulsion. But the question remains unanswered, How is it possible that this small and very active heart motor can pump the blood through this long system of tubing, in spite of enormous resistance, with comparatively small expenditure of power? As yet far too little importance is assigned to those accessory factors of the circulation that depend partly on internal factors, that is to say, the technical structure of this complicated vascular system, and partly on external factors. I will mention only the most important of these. The cross-section of the vessels decreases toward the periphery, but the number of branches of these vessels is greater than the decrease in cross-section, therefore, the total cross-section of the vascular system increases toward the periphery. So friction, that is to say, resistance, becomes less as we approach the periphery. Generally speaking, the hydrostatic pressure of the circulating blood aids the circulation in the main, according to the position of the heart, but varies with the position of the body, with the atmospheric pressure, etc. In the veins, again, the valves compensate in some measure for the hydrostatic pressure, which works there in the opposite direction to the circulation by the expiratory suction toward the abdominal cavity and the inspiratory suction toward the thorax. The voluntary muscles also support and further the venous flow toward the heart, but the most important accessory factor of the circulation is the capillary system. The knowledge of the structure and function of the capillaries is the outcome of very recent study, and, although our knowledge of this subject is still far from complete, we can to-day accept it as a fact that the capillaries are not regulated by the central nervous system. Personally, I have always held the view that the capillaries are enabled to regulate their own lumena by chemical stimuli, that is to say, by metabolic processes, and thus, by the swelling out and contraction of their own protoplasm, to take part in the work of the circulation. This idea has slowly crystallized, after many years of research on the capillaries, but we should not in any way infer from it that the work of the heart itself is of secondary nature or unimportant for the circulation. On the other hand, the knowledge of the active co-operation of the capillaries in the work of the circulation seems to fill up the gaps in our knowledge, and has helped to solve many problems.

One of these is the question of the physiologic effect of physiotherapeutic agents, especially of baths. What are the stimulating factors that act on the skin in baths? Where does the effect take place? How does it manifest itself in the circulation?

Different Varieties of Baths.—Carbon

dioxide baths occupy the chief place here, although other baths are used in the treatment of heart disease. In Europe we can distinguish the following groups of spas, the waters of which are used for physiotherapeutic treatment of diseases of the circulation:

(1) Cold chalybeate springs containing CO_2 (for instance, Cudowa, Pyrmont, Schwalbach, Franzensbad, Steben, Elster and others).

(2) Cold CO_2 saline springs (for instance, Homburg, Kissingen, Orb, Soden and others).

(3) Natural thermal CO_2 strong brine springs (for instance, Nauheim, Oenhausen).

(4) Artificial CO_2 baths—CO_2 produced chemically (prepared by Sandow, Kopp and Josef, Zucker, etc.).

(5) Artificial CO_2 baths—impregnated with CO_2 (apparatus by Keller, Fischer and Kiefer, Michal, Paschlaete).

Stimulating Agents in These Baths.—These may be classed under the following headings:

(1) Chemical
(2) Thermal
(3) Mechanical
(4) Electrical.

(1) Chemical.—The specific stimulating chemical agent of the CO_2 baths is, of course, the gas itself. It has a distinctly stimulating effect on the sensory nerve endings, and the salt constituents of these baths act in a similar way.

(2) Thermal.—The thermal element of the CO_2 baths is of a threefold nature: Firstly, the temperature of the bath water (it can be warm or cold); secondly, the carbon dioxide gas itself, which has a warm stimulus, even at temperatures far below the usual bath temperature; thirdly, that stimulating factor, which is specific for carbon dioxide baths, and which I have called the thermal-gradation-contrast factor. We know that what we call the thermal indifferent point is much higher for water than for gas. The CO_2 baths are usually given at a temperature somewhat below this thermal indifferent point. This, in a water bath, would be felt as far too cold, but the gas contained in these baths (which, of course, has the same temperature as the water) acts as a definite warm stimulus to the skin, which is coated by particles of the gas. Thus, what I call a thermal-gradation-contrast is felt, and a definite physiologic effect is produced.

(3) Mechanical Factors.—Mechanical stimuli are an important factor in treatment by baths, and are of a quite special nature in CO_2 water baths.

(a) The Hydrostatic Factor.—In every water bath the weight of the body is more or less compensated for, so that the muscles can be completely relaxed; in the gaseous bath this compensation is almost perfect, similar to that of a highly concentrated brine bath. The upward impetus of these baths is so great that it is even necessary to fix the body in order to keep it under water. Besides this, there is another effect on the cardiovascular system that is even more directly hydrostatic.

In an article published in 1912 on the effects of baths I said: "The circulation is supported by the fall of pressure between two great vascular regions, one externally, the other centrally. By the pressure of the water, the already existing high pressure on the peripheral vessels is increased, and thus the difference in pressure between that and zero, or the negative pressure of the more central vessels, is gradually increased. Both these factors bring about a distinct unloading of the periphery, and aid the venous flow to the heart. This lightens the work of the left heart. At the same time the increased pressure from outside on the arterial capillaries of the periphery necessitates a rise of blood pressure, for the left ven-

tricle has to work harder against the raised external pressure." This was confirmed experimentally by Tigerstedt, thus giving proof of the truth of the observation made by my brother and myself in 1906, namely, that half-baths influence the blood pressure in quite a different way from full baths. Similarly, the hydrostatic factor of the water bath brings about changes in the capillary pressure. As I pointed out in 1925, in a publication on "Treatment by Physiotherapy of Cardiovascular Disturbances," water baths appear to have a regulating and equalizing effect on the capillary pressure. There is also another but a much less important effect in the mechanical stimulus of the gas bubbles that pass over the surface of the body.

(b) Carbon Dioxide as a Mechanical Factor.—Lastly, I have always looked upon the inhibitory effect of the CO_2 bath on the gas-exchange of the skin as an important mechanical factor, and while Winternitz was endeavoring to prove experimentally that carbon dioxide made its way into the blood stream through the skin in a CO_2 bath, I maintained, and have since actively supported, my own hypothesis. It is, namely, that CO_2 is physiologically expired, and that probably some oxygen is inspired through the skin. It has never been proved that CO_2 makes its way into the body through the skin unphysiologically in a CO_2 water or gaseous bath. Even in an ordinary water bath, the CO_2 excretion of the skin is somewhat inhibited, but the inhibitory effect of the CO_2 bath on skin respiration is much greater, for, as soon as the body is covered by a gaseous mantle of CO_2, there is a fall to zero of the CO_2 of the tissues. Thus we get a CO_2 stasis or retention in the periphery, that is to say, in the skin.

Effects of Carbon Dioxide.—What is the physiologic effect of this CO_2 retention in the skin? It is twofold. It has a direct effect on the capillaries, and an indirect effect on metabolism. This is achieved through the agency of the vegetative nervous system.

To sum up in a few words the specific stimulating effect of CO_2 on the cardiovascular system, we find that it acts in three ways:

(1) The CO_2 contained in the water produces a chemical stimulus, which acts on the nerve ends in the skin;

(*a*) on the temperature sense as a heat stimulus;

(*b*) on the pain sense as a chemical stimulus;

(*c*) on the tactile sense as a simple contact stimulus (by the bubbles of gas).

(2) At the same time the CO_2 gas gives a powerful upward impetus to the body. It almost neutralizes the body's weight in the bath, and thus impedes the usual hydrostatic fall in the circulatory apparatus.

(3) The CO_2 of the water inhibits the gas exchange of the skin and thus inhibits the normal excretion of CO_2 from the skin.

Before discussing the effect of the baths, I will give a brief description of Bad-Nauheim, as the classic representative of spas for cardiac treatment.

General Information.—Bad-Nauheim is situated at an elevation of 440 feet above sea level, in a valley running from north to south. The climate corresponds to that of the western part of central Germany. The average temperature for the year is 8.6° C.: that for May 12.5° C.; for June 15.6° C.; for July 17.2° C.; for August 16.0° C., and for September 12.8° C. The average barometric pressure for the year is 749.1 mm.: for May 748.3 mm.; for June 748.9 mm.; for July 749.3 mm.; for August 749.2 mm., and for September 750.3 millimeters. The average relative humidity for May is 75 per cent, for June 74 per cent, for July 75 per cent, for August 78 per cent, and for September 85 per cent.

These figures clearly show that the summer climate of Bad-Nauheim is temperate.

Even in the height of summer, the cooling effects of the neighboring Taunus Mountains, the woods, the lake, and the evaporation works make themselves pleasantly felt, and one of the merits of this climate is the fact that cool evenings and nights follow the hottest days. Bad-Nauheim has an excellent water supply, provided by the group of waterworks constructed in 1907, which distribute the purest spring water from the basalt of the Vogelsberg. The general health record of the town is uniformly good, the death rate low, and epidemics are practically unknown.

Bad-Nauheim stands in the first rank of spa resorts. Its public and private bathing establishments are well managed and attractive. There are a number of first class hotels and pensions as well as houses of simpler pretensions, so that each may find the accommodation which suits his taste and his purse. Careful attention is paid in all establishments to diet that may be specially prescribed. Accommodation for patients in reduced circumstances is provided by a series of houses run by the municipality and by various charitable bodies.

Since prehistoric times, the district has been known for its salt works. The brine bath institute of Nauheim, however, was not founded until 1835, in which year nine bath rooms were opened. This number soon proved inadequate, and, owing to the ever increasing influx of patients, additional bath houses were built in rapid succession, until, in 1905, the present combined spa establishment, replacing the former antiquated buildings, was begun on the original site. The last link in the chain of improvements was forged in 1909 by the completion of the six large buildings enclosing the "Brunnenhof," and the three effervescing springs (Badesprudel), an arrangement noteworthy, not only for its hygienic utility but also for its artistic merit. The waiting-rooms, corridors, and bath rooms are high, commodious, and well ventilated. Every building is provided with central heating, supplied from a plant erected for the purpose near the railway station. Thanks to the new buildings, the number of bath rooms has been increased to 401, accommodating 432 bathers at one time and upwards of 6,000 a day.

As soon as the reconstruction of the bathing establishment was finished the rebuilding of the adjoining Trinkkuranlage was begun. These are laid out with colonnades, ornamental gardens, and fountains. Their opening in 1911 brought the reconstruction of the establishment to a close.

REMEDIAL MEASURES

1. The Springs.—The springs of Bad-Nauheim are rich in iron, carbon dioxide, and common salt. They originate in the clefts of the devonian schists which form the Taunus. In the course of its long underground journey, the water passes through deposits of sale, or of salt-bearing clay, from which it derives its salt content; then through limestone strata, which, under the influence of the high temperature, saturate the water with carbon dioxide. The carbon dioxide contained in this warm mineral water is under considerable pressure from the water column above it, but when it has risen from the lower depths to between 60 and 90 feet below the earth's surface, a large proportion of this gas is liberated, thereby forcing the mineral water upward, so that it is thrown into the air as a spray. The temperature of the springs which have their origin at considerable depths approximates closely to that of the underground sources from which they rise. These are the springs used for the baths. Those which have their source nearer the surface, and are mingled with fresh water, have a lower salt content and temperature, and are used for drinking. The chemical composition of the various springs varies with the nature of the strata from which they spring.

Three effervescing springs, Nos. VII, XII, and XIV, provide water for bathing purposes, at the regular rate of approximately 528,000 gallons in 24 hours, or enough for 6,000 baths a day. Clearly, the depth of the origin of the springs renders their output totally independent of atmospheric variations.

Six springs supply the water for drinking: the Kurbrunnen, the Karlsbrunnen, the Ludwigsbrunnen, and the Schwalheimer Brunnen. The two last-named are also used for bottling, and provide an excellent table water.

The actual quantity of free carbon dioxide contained by the effervescing springs in gaseous form was first determined in March, 1913, by means of special apparatus. All earlier estimations gave much too low a figure.

The Siedehausquelle is the chief spring supplying the Kurbrunnen baths.

The mother-lye of the Bad-Nauheim waters has a specific gravity of 1.433, and is of alkaline reaction.

2. *The Baths.*—A glance at the temperature of the various springs (Table I) shows that the natural temperature of the water renders them eminently suitable for bathing purposes, in striking contrast with other resorts where artificial heating has to be employed. The only exceptions are the so-called Kurbrunnen baths, and the ordinary brine baths. Further, as has been pointed out already, the springs escape from the earth under great pressure, thus supplying the faucets without any need for pumping machinery.

The water of the three bath springs (bubbling) is used in the following types of baths:

(a) Sprudelbad.—The spring water is led directly from the bore to the faucets, without coming in contact with the atmosphere in any way.

(b) Thermalsprudelbad.—The water of the effervescing spring is led in pipes, as before, directly from the bore, but in this case it is stored in closed containers, from which the bath faucets are supplied. This type of bath closely resembles the ordinary "Sprudelbad" in that the water does not come in contact with the atmosphere, but, owing to its storage in the containers, the water, when it reaches the baths, has suffered only a slight loss of temperature and of carbon dioxide, and can hardly be said to be gas-free.

(c) Termalbad.—The water used for this type of bath is collected as it comes from the main pipe in large open reservoirs in which it remains exposed to the air. A portion of the carbon dioxide is thus lost, and the water becomes discolored by the precipitation of iron and lime salts. This brownish-yellow water serves for the preparation of thermal baths.

(d) Strombad.—By a special arrangement of the faucets the water can be made to flow continually through the bath. For this purpose either "Sprudel," "Thermalsprudel," or "Thermal" water can be used.

(e) Solbad (Brine bath).—The brine for these baths is obtained by evaporation (*Gradierung*) of the effervescent spring water, by which process it is freed from iron and lime salts, and from carbon dioxide. This brine is artificially warmed for use in the baths.

(f) Kurbrunnen.—This type of bath was introduced in 1912-13. It is prepared from a mixture of the water of the various cool drinking springs and that of the so-called "Siedehausquelle." It contains, in addition to approximately 1½ per cent of salts, a very large proportion of carbon dioxide. This water is heated to a temperature of 35° C. in closed containers by means of heating coils.

All the baths can have their salt content increased according to requirements by the

addition of Bad-Nauheim mother-lye and brine. Convenient preparations of Bad-Nauheim salts are made which can be sent to patients who are not able to leave home. Each packet contains sufficient salt to prepare a brine bath, but without carbon dioxide.

higher proportion of carbon dioxide than will be found in the bath as finally prepared from such water, for a large volume of the gas is lost in the necessary heating process.

3. The Drinking Springs.—Among the drinking springs of Bad-Nauheim are the Kurbrunnen and Karlsbrunnen, which yield

TABLE I

Sample taken	Active CO_2 (Comprising free and half combined CO_2)		Free CO_2		Temperature
	gr.	c.c.	gr.	c.c.	At.
1. At the source	3.6212	2,051	2.8733	1636	32.98° C.
2. At the bath tap	2.3039	1,307	1.5560	882	31.70° C.
3. In the full bath	1.9165	1,088	1.1686	663	31.7 C.
4. After use	1.8162	1,031	1.0683	660	31.6 C.

The water thus contains substantially less carbon dioxide in the bath than at the source. As soon as the spring water issues from the earth, the pressure under which it has existed is reduced. As a result of this, a certain proportion of the carbon dioxide is given off. In order to prevent the air in the bath rooms from becoming unduly charged with carbon dioxide, the conduits are fitted with special gas-escape valves. In a bath of 88 gallons, from Spring No. XII, the following quantities of salts were found:

Sodium chloride	11,137.93 grammes
Sodium bromide	5.00 grammes
Potassium chloride	343.79 grammes
Lithium chloride	25.68 grammes
Ammonium chloride	23.59 grammes
Calcium chloride	1,132.93 grammes
Magnesium chloride	216.63 grammes
Calcium sulphate	33.55 grammes
Calcium bicarbonate	736.43 grammes
Strontium bicarbonate	20.51 grammes
Ferrous bicarbonate	11.95 grammes
Manganese bicarbonate	2.13 grammes
Disodium phosphate	0.16 grammes
Disodium arsenate	0.29 grammes
Silica	7.96 grammes
Total solid contents of 88 gallons, *i.e.*, 13.7 kilogrammes of salt	13,698.55 grammes

It should be noted that this analysis of water in the bath cannot be compared with the estimation of carbon dioxide in the case of cool springs made at the natural temperature of the water. The latter give a much

sodium chloride water containing carbon dioxide, and the Ludwigsbrunnen, an alkaline muriatic spring. The first two also possess a high radium emanation content. The water from these springs is drunk either pure or diluted with water from the Ludwigsbrunnen, or from the Schwalheimer springs. These drinking waters are all conveyed in conduits directly from their sources to the new pump-rooms, where they are distributed to patients, and where the waters of all other spas, German and foreign, may also be obtained.

4. Inhalation Treatment is also a feature of Bad-Nauheim. The Inhalatorium, in the Kurmittel Buildings in the Zanderstrasse, is a model establishment. At the back of the building are two large rooms in which many patients can be treated by inhalation simultaneously. These are fitted with Hayer's spray apparatus. There are also five rooms fitted with the best and most modern forms of apparatus. Brine from the various Bad-Nauheim springs is used for atomization in the sprays. Sometimes medicaments are added, as needed. Two pneumatic cabinets complete the establishment. Free inhalation treatment is provided by the salt evaporation works, extending over 1,100 yards, skirted by promenades. The air in the neighbor-

hood of these works is as delightfully refreshing as sea air.

5. Other Remedial Measures.—Special treatments can be added, in particular cases, to the ordinary bath and drinking cures. These include:

(*a*) Douches of various kinds and sitz-baths with fresh or salt water, which can be regulated accurately as regards strength and temperature.

(*b*) Electric light baths, four-cell, and alternating-current baths may be obtained in the Zander Institute, while sand and mud baths are provided in the Konitzkystift.

(*c*) Fango-packs.

(*d*) The state hospital has a department for light treatment, including artificial sunlight produced by the methods of Bach and Professor Jesioneck, *spektrosol* and Sollux lamps, and mebolith carbon arc lamps.

(*e*) Diathermy apparatus is provided in the state hospital and in the Medico-Mechanical Institute.

(*f*) The Medico-Mechanical Institute, under medical supervision, contains two large gymnasiums, for male and female patients, each equipped with complete Zander-Stockholm and Herz-Wien apparatus, in addition to Frenkel's apparatus for compensatory exercises, etc.

(*g*) Manual gymnastic exercises and massage by well trained assistants.

(*h*) Institute for whey and milk treatment, under veterinary and police control, providing fresh milk, whey, *kephir yoghurt*, sour and sterilized milk.

(*i*) Oertel's treatment.

Effects of Waters.—Before discussing the effects of baths, I will add a word on the spa treatment in general.

Spa treatment in diseases of the liver and for constipation, etc., should be given in cardiac cases only under the strictest medical supervision. X-ray examination of the digestive tract is an essential part of this treatment. If a bismuth meal be given twenty-four hours before starting the waters, their purgative effect can be clearly demonstrated. By intravenous filling of the gall bladder twenty-four hours before waters are taken, the stimulating effect on bile secretion is clearly seen. By adopting these measures as a routine practice, I have been able to study the effect of Nauheim waters closely.

The Effect of Baths on Normal Persons.—The problem to be solved is: What effects have these specific stimulating factors of the CO_2 baths (*a*) on a normal cardiovascular system; (*b*) on the physiologically changed system? In the past we have sought to solve this problem empirically. Of late years, experimental and surer methods have been adopted. Empirically we find the following: In normal persons with sound hearts, ordinary methods of examination give little or no information. A sound circulation merely reacts slightly to temperature effects. There may also be slight specific effects reinforcing these temperature stimuli. Speaking in general terms, one can say that cold CO_2 baths raise, warm baths lower, the blood pressure; cool baths constrict the peripheral arteries, and warm ones increase their lumen, as shown by plethysmographic examination. The pulse is slowed, and the volume per beat increased. The capillary flushing is increased by the dilatation of the vessels.

Effect of Same Bath on Patients.—In the case of an impaired cardiovascular system, a more distinctly regulating effect is apparent. This acts on respiration, pulse, and blood pressure. A low blood pressure is raised, whilst a high one is lowered. A slow pulse is quickened, a rapid pulse slowed. Besides this, there are two effects always specifically noted by patients: one is the flushing of those regions of the skin that come in contact with the water, the other is the very noticeable diuresis which

comes on, sometimes quite soon after the bath, and is often regarded by patients as an unfavorable sign. Time forbids my dwelling on the changes in pulse, blood-pressure rhythm, and other striking changes shown by the electrocardiograph after baths. I could also show you X-ray films demonstrating the clearing up of signs of stasis in the lungs. Edema disappears; also congestion of the liver.

One of the most important effects of CO_2 baths is the greatly increased diuresis. This is often striking in cases where retention had not been a marked clinical sign. This important expression of the effect of the baths can be fully recognized only by careful daily estimations of intake and output of fluid. I will mention one of many patients who have thus responded to the baths. A woman of 61, with fairly advanced myocardial changes; moderate enlargement of heart; auricular fibrillation; blood pressure raised. There was a twofold cause of the myocardial change; one, an old mitral disease, and the other marked dysfunction of the thyroid. Diuretin and digitalis were first given. Diuresis was increased, but went back again, but, on starting the baths, her curve showed a steady and constant rise of urine secretion, which persisted throughout the cure.

Summing up the results of our investigations, we find that although the normal cardiovascular system reacts but slightly to these CO_2 baths, the results are most striking in heart patients, the chief effects being a distinct regulation of pulse and blood pressure, and an increased capacity for work on the part of the whole cardiovascular system.

Interpretation of Results.—For half a century this increased work capacity has been explained on the grounds of a reflex stimulation of the heart itself as circulatory motor. That is to say, it is the summation of the various stimuli affecting the nerve ends in the skin in a CO_2 bath, which reach the heart through the agency of the sympathetic nervous system. This, no doubt, explains part of the effect produced, but the greater and the more important part of the results obtained, especially the striking after-effect of each bath, remains unexplained so long as we neglect the part played by the peripheral accessory factors of the circulation.

Returning to the problem of the CO_2 retention in the skin. What is the physiological effect of this phenomenon? Theoretically we can answer this question as follows: (1) The accumulation of CO_2 in the skin must react in some manner analogous to that of protein body therapy, or the intracutaneous injection of F. Müller. (2) Its reaction on capillaries and circulation generally is similar to that produced by fever or by physical work. I cannot enter here into the experimental proofs of these theoretical conclusions. Much work still remains to be done to amplify and co-ordinate the results gleaned from our experiments.

Influence of Baths on Respiratory Metabolism.—I will go a little more fully into one question—that of the changes which take place in respiratory metabolism in the CO_2 baths. Groedel I. was the first to show, in 1880, that the respiratory volume was increased in the CO_2 bath. Winternitz repeated his experiments, and came to the same conclusion, *i.e.*, that the carbon dioxide of the expired air is increased in the CO_2 bath, and that this increase is the result of resorption through the skin. For years I have maintained that this conclusion is erroneous. Laqueur's recent investigations have brought him to greatly modify his original views on this matter, but the problem can be solved only by minute investigation of metabolism during these baths, done with a more perfect technic and every possible precaution to exclude error. This is not the place to enter into discussion of the reasons why previous researches on this

point by Winternitz, Magnus, Liljestrand, and Laqueur do not lead to the same conclusion. All this will shortly be published in detailed form. To-day, I will only briefly mention some of the results of Dr. Wachter's—my collaborator's—long and arduous work on this subject. During the clinical all-important first ten minutes of the bath, we find that, in a normal healthy individual with sound heart, all phenomena are very much more varied and more individual in an ordinary water bath, where the oxygen consumption is increased, and the CO_2 output is little, if at all, raised. In the CO_2 water bath, on the other hand, phenomena are more definite and uniform. The rise in oxygen consumption is greater, and the output of CO_2 is very greatly increased, going up far beyond plus of the intake of O_2. In the CO_2 gas bath, the O_2 consumption is again increased, but less so than in the CO_2 water bath. The same applies to the output of CO_2. In a series of observations made for time-periods varying between 20 and 40 minutes, it was found that in the ordinary water bath the intake of O_2 and the output of CO_2 were very slightly increased, but that in both CO_2 water and gas baths, the intake of O_2 was very gradually reduced, whereas the CO_2 output increased enormously and in proportion to the length of the bath. We may definitely conclude from this that in any kind of bath, even in an ordinary water bath, the output of CO_2 is increased, though in the latter case in less degree, and less uniformly. As the patient cannot absorb CO_2 in an ordinary water bath, my theory would prove to be correct, that the cause of the increased output of the respiratory CO_2 (1) in an ordinary water bath; (2) in a CO_2 water bath, or (3) in a CO_2 gas bath, is the change in the CO_2 output of the skin. If, as was thought by previous workers, only the CO_2 output were increased and not the intake of oxygen, we might consider the whole matter to be merely a question of a more thorough washing out of CO_2, and that it was not caused by increased metabolism. However, since, as shown in our experiments, the oxygen intake is increased, the whole question becomes one of increased metabolism, as in fever and arduous physical work. But there is a difference between this increased metabolism and that produced by fever or work. It is best shown by the fact that in all our experiments the body temperature is lowered in the CO_2 bath, in spite of a distinct sensation of warmth, while in fever and work it rises considerably. From this fact we further conclude that the CO_2 retention in the skin acts as a stimulus to metabolism, and that metabolism is stimulated in the periphery itself, *i.e.*, directly in the cutaneous capillaries, and not by way of the central nervous system. We also see from this, and from observations on pulse and blood pressure, that the older school of physicians were perfectly right in considering that the CO_2 water baths represented a rest for heart and circulation, and my own theory becomes justified, that, in disease of the cardiovascular system, balneotherapy is a stimulation therapy in the sense described by Papoff. Lastly, I am supported by these findings in my hypothesis that the most important effect of CO_2 baths is not to be sought in the nerve ends of the skin, but, rather, in the skin itself. The intracutaneous CO_2 retention transforms the physical stimulus into a chemical one. Thus, physical methods become medical-therapeutic ones, only we start from another point of view. In the near future I hope to report in detail on the individual reaction noted in patients suffering from various forms of heart disease during estimation on respiratory metabolism; further details of Dr. Wachter's research will also be included.

It is erroneous to conclude that only CO_2 baths are of importance for the treatment of cardiac disorders: all baths, used scientifi-

cally and with care, can be of great value here.

Artificial CO_2 Baths.—These are extremely useful, provided the technic, which is often neglected, is sufficiently meticulous. The following brief rules should be observed when giving both natural and artificial CO_2 baths. Every patient reacts differently, therefore prescribing baths is a matter of clinical experience and individual knowledge. The important things are that the patient should not become dyspneic, nor should he suffer from cold or from undue heat. The pulse should become quiet and fuller. It is best to begin with half-baths, and to increase gradually. Excited patients, and those with high blood pressure and anginal conditions, should never have full baths. The surface of the water should not extend over the mammillæ. It is important to prevent the inspiration of CO_2. Temperatures must be prescribed individually, and very slowly reduced. Generally speaking, the limit of temperature for an asthenic patient is 37° C., for a patient with Graves' disease 28° C., for aortic incompetence about 33° C., nephritis 35° C., and angina pectoris about 35° C., but all this must be worked out individually.

Duration of Bath.—It is best to begin with short baths of from 6 to 8 minutes. Patients suffering from heart disease should not stay in the water more than 12 minutes. Baths should be taken an hour after a light breakfast of coffee and rolls, and two hours' rest in bed after the bath is absolutely essential. It is also essential to modify the life as regards work and pleasure, in order to get value from the bathing cure. Also, to get the best results an after-cure is necessary.

These are brief rules, but their brevity should not lead one to look upon the prescribing of baths as a simple matter that can be left to lay persons.

Indications and Contra-indications.—In conclusion, a word regarding indications for balneotherapy, a matter on which there has been much difference of opinion. This is quite wrong. With complete mastery of bath technic, there is hardly a contra-indication. The only real contra-indications are in patients with fever or with a considerable degree of heart failure. Also those convalescing from embolism (intervals of six months), and patients with very high blood pressure—these only after careful tentative bath treatment has been found useless.

Taking a brief survey of the value of CO_2 baths in disturbances of the circulation, we find that the mechanism underlying the physiological effect of these baths is quite as capable of scientific interpretation as is that of most of our therapeutic remedies. Clinical experience has shown us that balneotherapy, applied rightly, is quite equal to any other mode of treatment. The experienced physician should thoroughly understand its application to the individual case.

DISCUSSION

DR. A. W. CRANE (Kalamazoo, Mich.): I can see that one of the most enjoyable misfortunes that can befall a man would be to have heart disease and be condemned to spend several months in this delightful district concerning which we have just heard. I have no doubt that the cure for heart disease under these circumstances might be repeated each year with benefit. From the Doctor's paper I judge that the part played by the X-ray in physical therapy of the heart consists in watching the effects of the stimulation of the skin upon the size of the heart. I did not have the opportunity of reading this paper before the Doctor gave it, so that I am not at all sure as to just what ground is taken. On several points, however, we might possibly take issue regarding this treatment of heart disease without some discrimination as to the

cause. For example, heart disease may be the result of old thyroid disease, or it may be the result, as it frequently is, of syphilis, or it may be a result of a bacterial invasion from tonsils or septic teeth in the production, first, of an inflammation of the heart lining and ultimately of a valve, producing a valvular disease, or it may be the result of a renal lesion causing high blood pressure and resulting strain on the heart. It is quite obvious that in a consideration of the causes would lie the manner of treatment, which could not always be put down as the stimulation of the skin by baths. When it comes to the matter of high blood pressure, we may say that almost without exception high blood pressure is a matter of renal function. It is the automatic regulation of blood pressure to insure a steady flow of blood through the kidneys. If the involvement of the kidney vessels is such as to demand high blood pressure in order that the kidney may be functionally somewhere near normal, then any artificial interference with that blood pressure is obviously unsuitable. I believe that if we were to dilate the skin capillaries under those circumstances and lower the blood pressure, we would very likely have kidney symptoms, no matter what the X-ray might show regarding the size of the heart. I only mention that to indicate the grounds upon which discussion might proceed, and I would question very much the treatment of heart disease by this method unless a careful consideration of the causes entered into the problem. I say that without the idea of criticism and I say it largely in ignorance of exactly what the author meant to bring out, but I think we might raise these questions, inasmuch as the treatment of heart disease was presented by the author. I think I may say in conclusion that in the whole question of the examination of the heart, the determination of its size, and the popularization of that method of examination, more has been done by Dr. Franz Groedel than by any other European authority.

FRACTURES OF THE BONES OF THE FACE[1]

By P. F. TITTERINGTON, M.D., St. Louis

IN reviewing the literature, very little can be found concerning fractures of this type. A certain number of authors, chiefly Bowen, have given the subject consideration, and this paper will deal with the methods as used in our practice.

At this time, only the malar bone and its attachments and the zygomatic arch will be considered. Other positions about the head and neck are being studied, but, as yet, their value and practicability have not been sufficiently proved for presentation.

A brief review of the anatomy shows the malar to be a rather heavy diamond-shaped bone with four articulations to structures of a much more fragile construction. These articulations are with the external angular process of the frontal, the great wing of the sphenoid, the superior maxilla, and the zygomatic process of the temporal. The zygomatic arch is a long process projecting from the lower part of the squamous portion of the temporal bone, that articulates with the zygomatic process of the malar.

According to Da Costa and Scudder, the malar bone itself is rarely fractured. The fractures usually occur at its attachments, the zygomatic arch being frequently involved.

The deformity in these fractures consists of a depression to the outer side of, and below, the eye. If this depression impinges upon the coronoid process of the inferior maxilla, there will be a limitation of the movements of the lower jaw. Occasionally, the swelling of the soft parts is sufficient to produce this symptom. If the orbit is involved, there may be a localized subconjunctival hemorrhage; and, if the infra-orbital nerve is injured, there will be prickly

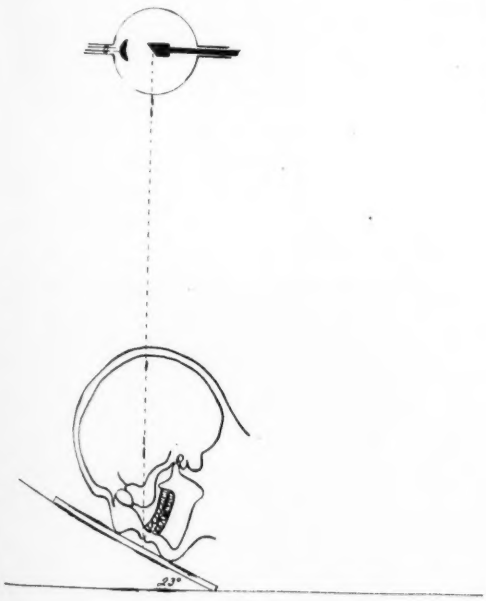

Fig. 1. Position to demonstrate the bones of the upper part of the face.

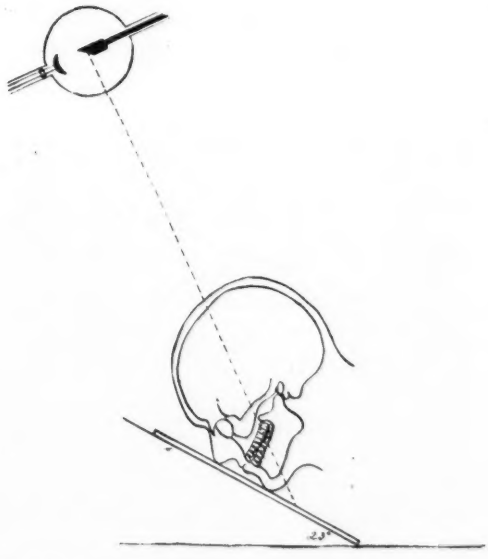

Fig. 2. Position to demonstrate the zygomatic arches.

[1]Read before the Radiological Society of North America, at the Thirteenth Annual Meeting, at New Orleans, Nov. 29, 1927.

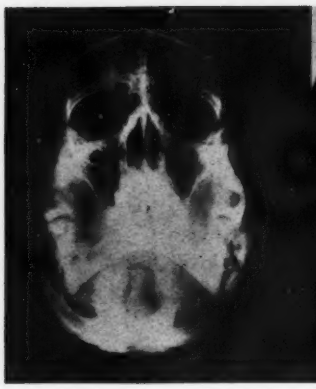

Fig. 3. Normal bones of the upper part of the face.

Fig. 4. Normal zygomatic arches.

Fig. 5. Fracture through the floor of the left orbit that extends down through the superior maxilla.

sensations along its course—*i.e.*, in the upper gums and in the skin of the cheek, nose, and upper lip.

In demonstrating the fractures in the bones of the upper part of the face, a position practically the same as that employed by Waters in showing the antrum is used. In the first position, the patient lies on the abdomen with the nose and chin resting upon a cassette supported by a twenty-three degree angle board. The central ray is directed straight downward so that it passes through the center of the malar bone.

In demonstrating the bones of the lower part of the face, especially the zygomatic arch, the head is placed the same as in the first position; the tube is tilted fifteen degrees toward the feet, and then moved toward the head of the table until the central ray passes through the mid-portion of the arch.

All this work has been done on the Potter-Bucky diaphragm at a 32-inch distance with 75 to 85 K.V., 25 ma., 3½ to 5½ seconds exposure, through 1 mm. of aluminum filter. The lower voltages and shorter exposures

Fig. 6. Extensive fractures of the bones of the upper part of the face.

Fig. 7. Comminuted fracture of the left zygomatic arch. (Same case as Figure 6.)

Fig. 8. Healed fractures through the attachments of the right malar bone.

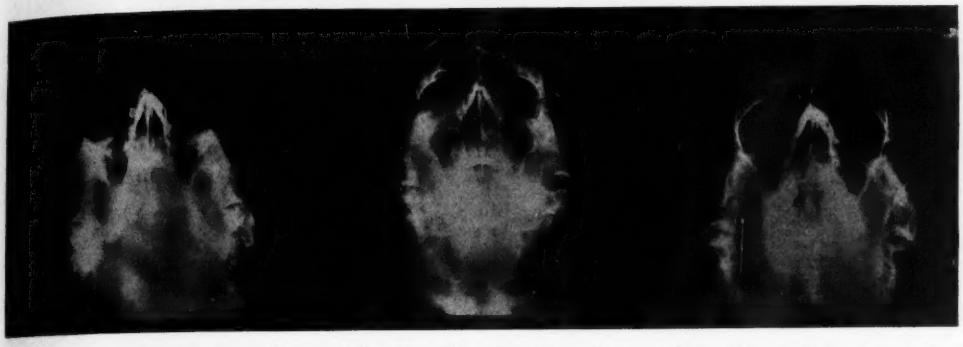

Fig. 9. Fractures through attachments of right malar bone. Eighteen months' duration; rather marked displacement of fragments and no union.

Fig. 10. The first bicuspid lying in front of the anterior wall of the left antrum.

Fig. 11. Triple fracture through right zygomatic arch.

are used in the first position, and the higher voltages and longer exposures in the second position.

Case No. 1 (Fig. 5). A male, age twenty-four, was struck over the left malar by a blow from a fist. There was a fracture through the floor of the orbit extending down through the superior maxilla at the malar articulation. There was a marked cloudiness of the antrum and a moderate subconjunctival hemorrhage. There was some involvement of the infra-orbital nerve, manifested by a tingling sensation in the cheek. No operative procedures were necessary because there was very little displacement.

Case No. 2 (Figs. 6 and 7). A male, age nineteen years, jumped from an automobile going thirty miles per hour and struck a telephone pole with the left side of face. The left malar bone was broken loose from all its attachments and the left zygomatic arch fractured beyond recognition. The contour of the left antrum was completely lost. At operation, all of the structures around the left malar were so badly comminuted that there was nothing to which it could be anchored. The right malar was broken loose from its attachments to the external angular process of the frontal and the superior maxilla. There was only slight displacement, with the zygomatic arch intact. There was also a fracture through the left mandible in the cuspid region, and through the base of the condyle of the right mandible. This fracture through the condyle is partially shown in the positions being described.

Case No. 3 (Fig. 8). A male, age fifty-eight, was thrown through a windshield. The examination was made one year after the accident, and a separation of the right malar from the external angular process of the frontal still remained. Portions of an old fracture line between the malar and the superior maxilla are visible, although a rather marked amount of union has taken place. There is also evidence of an old healed fracture between the malar and the zygomatic arch.

Case No. 4 (Fig. 9). A male, age thirty-six, fell forty-one feet from a telephone pole and struck the right side of the head and face. The examination was made eighteen months later, at which time there was a fracture beginning in the left frontal region, extending across to the right frontal, and curving downward through the roof and floor of the right orbit. The malar was broken loose from its attachments to the superior maxilla, and there were two frac-

tures through the zygomatic arch. There was a rather wide separation of the fragments, with no definite evidence of union. The fracture in the skull showed considerable union.

Case No. 5 (Fig. 10). A male, age thirty-two, was in an automobile which was struck by a fast freight train. The only injury was to the upper left bicuspids. The second bicuspid was completely removed and never found. Stereoscopic examination showed the first bicuspid to lie just in front of the anterior wall of the antrum.

Case No. 6 (Fig. 11). A laborer, age forty-eight, was injured by a piece of flying steel. The examination was made six months after the accident, at which time a triple fracture through the right zygomatic arch was found. There was a moderate depression of the fragments, with no limitation of the movements of the lower jaw. Very little union, if any, had taken place.

Case No. 7 (Fig. 12). An adult male was struck over the left side of the face by a heavy timber. The examination was made six weeks after the injury, when a triple fracture of the left zygomatic arch was found. There was marked depression of the fragments, without evidence of union. Movement of the lower jaw was limited about one-third. Operative procedure was refused.

Case No. 8 (Figs. 13, 14, and 15). An adult male was struck over right side of face by a large steel beam, resulting in a triple fracture of the zygomatic arch, with some depression. There was a moderate interference with the movements of the jaw, and nine days later the fragments were raised. The position of the fragments was exceptionally good, and, eleven months after the injury, union was complete without deformity. This last case is presented through the courtesy of Dr. George Gafney, St. Louis, and shows the degree of accuracy with which the positions can be duplicated, and the value of operative procedure in cases with wide separation or depression of the fragments.

Fig. 12. Triple fracture through right zygomatic arch, with marked depression.

Fig. 13. Triple fracture through the right zygomatic arch, with moderate depression.

These two positions have been used in twenty-one cases. This number is not sufficient to make a series from which definite conclusions can be drawn, but your attention is called to the following observations:

1. A certain percentage of fractures of the facial bones, especially those with only slight displacement, are easily overlooked. Three cases in this series were previously diagnosed as negative.

2. In cases examined shortly after the injury, extravasation into the antrum is frequent—a condition which apparently clears up in a short time.

3. Surgical intereference is indicated in those cases having a wide separation of fragments. In cases not operated on, union is slow or fails to take place.

4. When the trauma is directly over the zygomatic arch, a triple fracture, with depression, usually results. The fractures are at the articulations and through the center of the bone, the depression being at the middle fracture.

5. When the trauma is directly over the malar, the first fracture is at the articulation with the superior maxilla. The involvement of the other articulations of the malar and the extent of the fractures through these articulations are directly proportionate to the force of the blow.

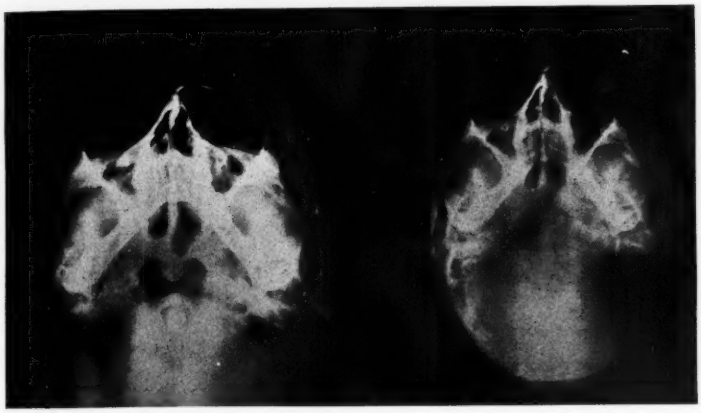

Fig. 14. Same case as Figure 13, after reduction.

Fig. 15. Same case as Figure 14, eleven months later. Union is complete.

DISCUSSION

Dr. E. S. Blaine (Chicago): There is little I can present that will be of particular profit after this very able discussion by Dr. Titterington regarding fractures in the malar bones. These are very difficult regions for X-ray demonstration of traumatic lesions.

I agree with him in the statement that, in the region of the face, only in the malar bone and its attachments have we shown sufficient X-ray detail to be worthy of much consideration. In the studies I have made of the facial bones in determining the anatomy of the head and neck, as revealed by the X-ray, particularly in cases of traumatic injuries, my experience has largely concerned the malar bones and the zygomatic arch. I have found, like the essayist, that the chin-nose position gives most information. In addition to this, the superior-inferior direction of sphenoidal projection will often show the contour of the zygomatic arches and thus aid in correctly determining whether or not an abnormality or malformation was present.

The importance of the posture of the patient in making this exposure cannot be over-emphasized. As Dr. Titterington said, the patient should be placed on the abdomen with the nose and chin resting upon

the cassette, supported by a 23-degree angle board, with the central ray directed straight downward so that it passes directly through the center of the malar eminence. This is the optimum for demonstrating fracture in the bones of the face.

In dealing with the bones of the lower part of the face, the head should be placed in the same position, with the tube tilted toward the feet and then moved at the same angle toward the head of the table until the central ray passes through the middle portion of the zygoma. Success depends on correct placement for the exposure.

The Light Erythema under the Influence of Menstrual Cycle and Pregnancy. Hans Dieterich. Strahlentherapie, 1927, XXVII, 587.

The author studied the skin erythema and pigmentation following exposure to a mercury vapor lamp in a series of female subjects. He found that in twenty-one out of twenty-five cases the menstrual cycle had a definite influence on the skin reaction. In the pre- and intra-menstrual period it appeared sooner and was more intense than after the menstruation and during the interval. In twenty-three cases of pregnancy the abdominal skin reacted with a stronger erythema of longer duration than the skin of the breast, while the opposite reaction was seen in non-pregnant women. Six to seven days following delivery the skin responded in the same manner as in normal women. Histological studies of the erythema area confirmed the findings of previous investigators. It is suggested that from the microscopic picture a penetration of certain rays into the corium is very probable.

E. A. POHLE, M.D.

Regarding the Rectal Radium Application. S. Simon. Strahlentherapie, 1927, XXVII, 70.

In certain cases of uterine carcinoma, it is advisable to add to the effective dose of radium by inserting an applicator into the rectum. The author describes an instrument which is constructed for this particular purpose. It is essential to stay within the medium dose in order to prevent violent reactions in the mucous membrane. The majority of patients did not complain much during the treatment; painful rectal and bladder contractures followed, however, in some instances. Tumors of the prostate and the bladder itself may also be treated by the described method.

E. A. POHLE, M.D.

INTRACRANIAL CALCIFICATIONS[1]

By JOHN T. MURPHY, M.D., F.A.C.P., Toledo, Ohio

A CONSIDERATION of calcified areas inside the skull is made at this time to indicate that care should be taken in the interpretation of these shadows. While calcified areas are not so rare as was supposed by the present writer in a previous communication, the finding of intracranial tumors which I have observed in the study of 150 cases of intracranial pathology. With regard to the incidence of the condition, I agree with the rest of the writers on the subject. From personal experience, I know that even extensive calcifications may appear very indistinctly on imperfectly

Fig. 1. Calcification in falx cerebri. Note shadow in mid-line.

Fig. 2. Calcification in falx cerebri.

shadows is still rare enough to be of interest, and, at times, confusing.

Ström, in a masterful paper, says as follows: "Up to the present time about 20 cases of intracranial calcifications, diagnosed roentgenologically, have been published. These were found in the study of about 100 cases of brain tumor and, therefore, the writers contend that the condition exists more frequently than is generally supposed."

Ström further says: "In this article, I wish to report two cases of physiological calcification and five cases of calcified brain taken X-ray pictures; and, considering the relative rarity of the condition, I can well understand how many cases are overlooked, without doubt not pathological."

CALCIFICATION IN THE PINEAL GLAND

The most common shadow seen and recognized as of no pathological significance is the calcification which occurs in the pineal gland. The writer has seen it in cases as young as 16 years of age. The incidence was over 40 per cent in 100 successive cases. The calcification is often the size of a pea and is situated about 3.5 cm. above the middle of the external auditory canal. There are often numerous smaller calcifications

[1]Read before the Radiological Society of North America, at the Thirteenth Annual Meeting, at New Orleans, Nov. 29, 1927.

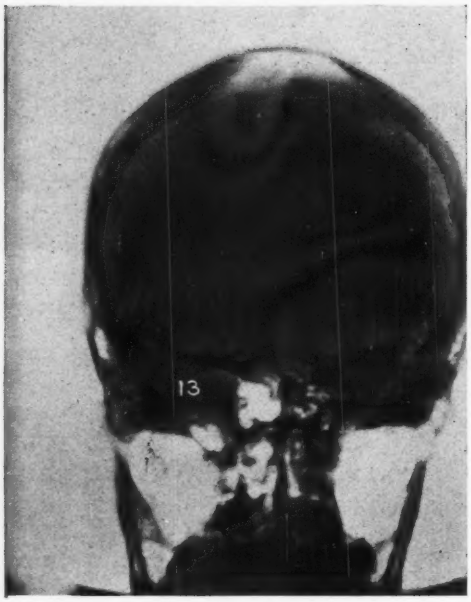

Fig. 3. Calcification of the falx, with apparent erosion of the skull.

about the same area, though the writer has never had the opportunity of checking their exact location in the brain. These are seen very often to lie close to the pineal shadow.

The pineal shadow is extremely difficult to show in a posterior-anterior view—oblique projections with exact technic will show it to be in the mid-line. It is of diagnostic value in the rare case of tumor in this region, in which case it may be displaced in any of four directions. Stereoscopic plates, even when carefully made, may not be entirely satisfactory, so great care must be used to determine this deviation. It is a test of the quality of one's plates, and good plates should always show it, when present, even if very small.

CALCIFICATION IN THE FALX CEREBRI

The next most common of these densities seen are in the calcifications in the falx cerebri. These may be of any size and occur in any part, although the writer has

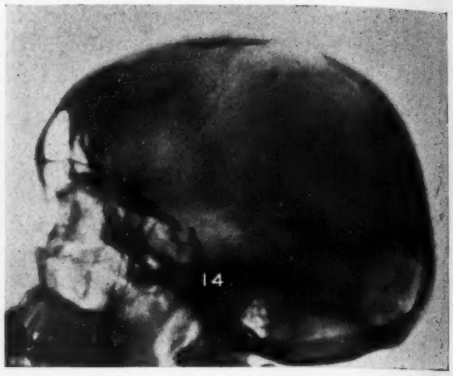

Fig. 4. Calcification of the falx, with apparent erosion of the skull. Lateral view.

never seen one posterior to the center of the skull in the anterior-posterior direction. They are usually very dense, can easily be seen in the posterior-anterior projection, and should cause no mistake in interpretation. They are of no clinical significance, but may occur in a skull in which there is pathology present. They may be displaced and in this manner be a clue to the location of the pathology. Figures 1 and 2 show a case of abscess of the brain. The posterior-anterior plate, as well as the lateral, shows the calcification well to one side. From its density and shape I think it is a displaced falx calcification. The abscess was confirmed at autopsy, but the position of the calcification was not looked for.

Figures 3 and 4 show a calcification of the falx, with a thinning of the skull near it. This patient showed no evidence of brain pathology. The plate was taken for supposed skull fracture.

CALCIFIED BLOOD VESSELS

Concentric rings of calcification occur in the skull. These may be found in many positions, but are most common in the region of the mid-brain. They are calcifications of the walls of the blood vessels. They show

Fig. 5. Calcification of the pineal gland, and, posterior to it, calcification of the choroid plexus.

Fig. 6. Calcification of the choroid plexus.

as small flecks of calcium, mentioned previously as occurring about the pineal gland (Fig. 5), or calcification of relatively large masses. These present very interesting plates, as Figures 6 and 7. The location of this one corresponds well to the choroid plexus of the lateral ventricle. I have also seen these rings in the anterior fossa, and

Fig. 7. Calcification of the choroid plexus.

Fig. 8. Calcification of inner table of frontal bone due to brain retraction in old age.

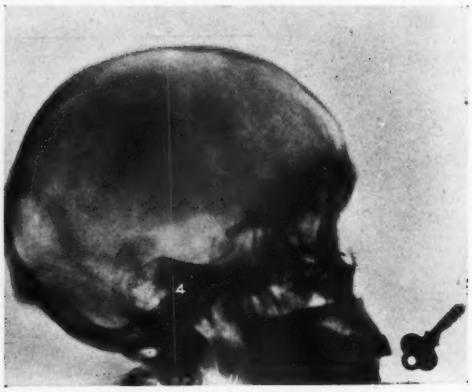

Fig. 9. Calcification of pituitary gland.

flecks, some too small to reproduce, are not infrequently seen in other locations on stereoscopic plates. No clinical significance can be attached to these except that of the general condition of the patient's arteries. They may, of course, be calcified aneurysms, from which they can not be differentiated.

Bridges of new bone formation about the sella turcica, as described so well by Schüller, are frequently seen in differing amounts. At times they are very marked, at other times very faint. The entire sella may be encased in new bone.

In very old persons, where there may be a definite retraction of brain tissue, the inner plate of the skull may take up this space, the new bone conforming to the brain markings as in Figure 8. This is a physiological process.

I would now like to present an unique case of calcification of the pituitary gland itself. This occurred in a dwarf with definite pituitary symptoms. No other evidences of tumor, however, were present, and none have developed. (See Fig. 9.)

To add to the foregoing, small areas of calcification, not in the blood vessels, are seen in the brain itself. They are found at routine examinations and are usually symptomless, but, in the face of symptoms, may well mislead the examiner to false conclusions. These latter are too faint for reproduction.

In closing, I would like to make special mention of the article by Ström from the clinic of Dr. Forssell, of Stockholm. To those interested in brain diagnosis, it will be worth a thorough study.

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THE TREATMENT OF TUBERCULOSIS BY HELIOTHERAPY[1]

By HORACE LO GRASSO, M.D., PERRYSBURG, N. Y.

WHILE the therapeutic value of sunlight has been recognized as far back as history records, it is only in the last decade that light treatment has begun to be used extensively.

Not very long ago, the pioneers in this field were repeatedly called upon to defend and justify the use of light in the treatment of disease. But times have been rapidly changing. Now, it seems, the value of light, both as a prophylactic and as a therapeutic agent, is so generally recognized that it falls into the category of things that are taken for granted. It may be that the pendulum has swung too far the other way. Whether for good or for evil, the popular press has seized upon it as a timely subject and has broadcast its virtues far and wide, so that light treatment promises to become quite the fashion.

Heliotherapy, contrary to the common belief, is not a specific remedy for disease (with the possible exception of rickets) in the scientific sense of the term. It prevents disease by bringing the body to its state of maximum resistance, so that it can ward off infection. It cures infections, once they are established, by summoning all the body's protective forces to the front. While it is valuable in most conditions in which the resistance is low and the body needs to be built up, its principal use has been directed toward the treatment of so-called surgical tuberculosis.

The beneficial results obtained in treating cases of this disease at the J. N. Adam Memorial Hospital and other institutions where heliotherapy is practised, have far surpassed anything ever accomplished by the use of surgery, which was formerly the accepted treatment. In a vast number of cases, operative procedure left the patient with dangerously lowered vitality, unsightly and disabling deformities, or non-healing wounds. He was frequently fated to life-long invalidism or untimely death. In contrast with these unfortunates, the sun-cure patient finds his physique splendidly built up, musculature well developed, and sinuses healthily closed. In the not-too-far-advanced cases of bone and joint tuberculosis, bone tissue is repaired and the function of the joint is preserved or restored. Blood examinations before and after treatment show a decided increase in the red cells and in the hemoglobin. Leukocytosis, when present, returns to normal, with a corresponding improvement in the patient's condition. The percentage of neutrophilic polymorphonuclear cells, when excessive, decreases, and in many cases an actual lymphocytosis results. As might be expected, patients having a substantially normal blood picture do not show any change on exposure to sunlight.

In its essential features our sun-cure technic is patterned after that of Rollier, although many modifications have been made to adapt it to our peculiar conditions and needs.

One of the first requisites is that exposure should be made in the open air, with nothing to intercept the sun's rays. South porches, opening from bedrooms or wards and screened against the prevailing winds, are ideal for this purpose, but any sunny space, enclosed by high close board fences or thick shrubbery, will serve, although with very weak, bedridden patients easy accessibility must be considered. The matter of wind protection is an important point and

[1]Read before the Radiological Society of North America, at the Thirteenth Annual Meeting, at New Orleans, La., Nov. 29, 1927.

should receive careful attention in giving sun-cure. While moving air playing on the body is desirable on a very warm day when still air is likely to be depressing, in cold weather a chilling breeze striking the body may do serious harm. On unusually cool, windy days, additional protection may be provided by canvas screens partly surrounding the beds. Since, in the central-eastern portion of the United States, such a condition is frequently met, we feel that provision for such screen may be profitably incorporated in the design of the bed.

We firmly believe that to apply sun-cure properly the whole body (with the exception of the head) should eventually be irradiated at one time, and that this ultimate stage should be reached by a series of steps carefully graded both as to duration of exposure and area of body surface exposed. The head may be protected by any convenient device that will satisfactorily shade it. Colored glasses for additional protection of the eyes are also advisable.

The initial treatment consists of a five minutes' irradiation of the feet, repeated three times during the day at suitable intervals, the rest of the body being covered with sheets or blankets. The irradiation is then extended, day by day, to legs, thighs, abdomen, and chest, five minutes being added daily to the insolation period of each previously exposed area until the maximum is reached. A suitable maximum for the average subject is three hours—an hour and a half morning and afternoon. In dealing with patients who can be turned easily, the anterior and posterior surfaces are irradiated alternately. Patients who suffer from excessive pain or weakness should be insolated in the position that is best for them until the time comes when turning is not too difficult. Then the whole procedure is repeated on the opposite surface of the body.

We do not, of course, claim any special virtue for the particular number of minutes mentioned in our schedule. But in order to have our nurses and attendants work efficiently, it is necessary to have a definite set of rules to be followed in all average cases. When an unusual case comes under observation, it is the duty of the attendant physician to make such departures from the general rule as will meet the individual needs of that patient. For example, when the patient shows marked debility, with high fever and pulse, it may be found advisable to proceed by a more minute gradation of the irradiation periods, as well as to shorten, for a time, the total daily insolation.

In the course of our experience we have come to realize the insufficiency of the time unit in the measurement of dosage. The method of recording sun-cure dosage in terms of hours and minutes is undoubtedly open to the serious criticism that no account whatever is taken of variations in the intensity of sunlight from season to season, from day to day, or from minute to minute, or of differences in quality and intensity of sunlight in different parts of the country. Dr. Brian O'Brien, our physicist, has worked for the past two years on a more rational system of dosage based on sunlight intensity and we now have a method which is simple and promises to be quite satisfactory.

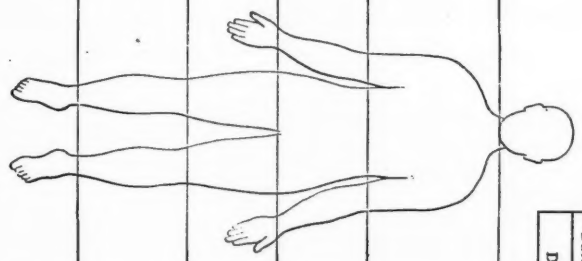
As a rule, the patient's toleration of sunlight can be estimated from the pigmenta-

Fig. 1. Treatment chart.

Form 6

J. N. ADAM MEMORIAL HOSPITAL

No._____ Name_____



Date																	
Days	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th	17th
	T.I.D	T.I.D	T.I.D	T.I.D	T.I.D	T.I.D	T.I.D	T.I.D	T.I.D	T.I.D	T.I.D	T.I.D	T.I.D	T.I.D	T.I.D	T.I.D	B.I.D.
Total Daily Exposure of part exposed longest	15 Min.	30 Min.	45 Min.	60 Min.	75 Min.	90 Min.	105 Min.	120 Min.	135 Min.	150 Min.	165 Min.	180 Min.	180 Min.	180 Min.	180 Min.	180 Min.	180 Min.
	5 Min.	10 Min.	15 Min.	20 Min.	25 Min.	30 Min.	35 Min.	40 Min.	45 Min.	50 Min.	55 Min.	60 Min.	60 Min.	60 Min.	60 Min.	60 Min.	60 Min.
		5 Min.	10 Min.	15 Min.	20 Min.	25 Min.	30 Min.	35 Min.	40 Min.	45 Min.	50 Min.	55 Min.	60 Min.	60 Min.	60 Min.	60 Min.	60 Min.
			5 Min.	10 Min.	15 Min.	20 Min.	25 Min.	30 Min.	35 Min.	40 Min.	45 Min.	50 Min.	55 Min.	60 Min.	60 Min.	60 Min.	60 Min.
				5 Min.	10 Min.	15 Min.	20 Min.	25 Min.	30 Min.	35 Min.	40 Min.	45 Min.	50 Min.	55 Min.	60 Min.	60 Min.	60 Min.
					5 Min.	10 Min.	15 Min.	20 Min.	25 Min.	30 Min.	35 Min.	40 Min.	45 Min.	50 Min.	55 Min.	60 Min.	60 Min.
						5 Min.	10 Min.	15 Min.	20 Min.	25 Min.	30 Min.	35 Min.	40 Min.	45 Min.	50 Min.	55 Min.	60 Min.
							5 Min.	10 Min.	15 Min.	20 Min.	25 Min.	30 Min.	35 Min.	40 Min.	45 Min.	50 Min.	55 Min.
								5 Min.	10 Min.	15 Min.	20 Min.	25 Min.	30 Min.	35 Min.	40 Min.	45 Min.	50 Min.
									5 Min.	10 Min.	15 Min.	20 Min.	25 Min.	30 Min.	35 Min.	40 Min.	45 Min.
										5 Min.	10 Min.	15 Min.	20 Min.	25 Min.	30 Min.	35 Min.	40 Min.
											5 Min.	10 Min.	15 Min.	20 Min.	25 Min.	30 Min.	35 Min.
												5 Min.	10 Min.	15 Min.	20 Min.	25 Min.	30 Min.
													5 Min.	10 Min.	15 Min.	20 Min.	25 Min.
														5 Min.	10 Min.	15 Min.	20 Min.
															5 Min.	10 Min.	15 Min.
																5 Min.	10 Min.
																	5 Min.

The amount of exposure, from this day on, is the same except that the periods are divided into a morning and an afternoon period of 90 min. each.

THESE EXPOSURES ARE TO BE DIVIDED EQUALLY FOR ANTERIOR AND POSTERIOR SURFACES WHENEVER POSSIBLE

Time for the above Exposures																	
	A.M.	8:45	8:45	8:45	8:45	8:45	8:45	8:45	8:45	8:45	8:45	8:45	8:45	8:45	8:45	8:45	8:45
	A.M.	9:50	9:55	10:00	10:05	10:10	10:15	10:20	10:25	10:30	10:35	10:40	10:45	10:45	10:45	10:45	10:45
	P.M.	3:15	3:15	3:15	3:15	3:15	3:15	3:15	3:15	3:15	3:15	3:15	3:15	3:15	3:15	3:15	3:15

MODIFICATION OF ROLLIER'S SCHEMATIC DIAGRAM OF INSOLATION

Fig. 1. Treatment chart.

tion of the skin. The pigment probably prevents the erythema-producing effect of the actinic rays and enables him to take long exposures without burning, with corresponding benefit. Occasionally, a patient is found who tans with difficulty and still makes good progress toward recovery, while, on the other hand, a re-activation of disease sometimes occurs in well-tanned subjects. But, on the whole, rapid and intense tanning may be considered a favorable prognostic sign. It is worth adding that since blondes in general are incapable of as deep pigment-production as brunettes, some consideration of the patient's race-type should be made in evaluating his pigment.

While the most striking results have been reported in so-called surgical tuberculosis, I wish to state at this point, that, contrary to the opinion of most of those who are practising heliotherapy and who advise against its use in pulmonary tuberculosis, I believe that sunlight, if judiciously applied, is just as beneficial in this type of the disease as it is in the surgical. A series of experiments on pulmonary cases carried out in the Summers of 1922 and 1923, and subsequent routine sunlight treatment of such

Fig. 2. Case No. 4090, on admission. Tuberculosis, first and second lumbar spine.

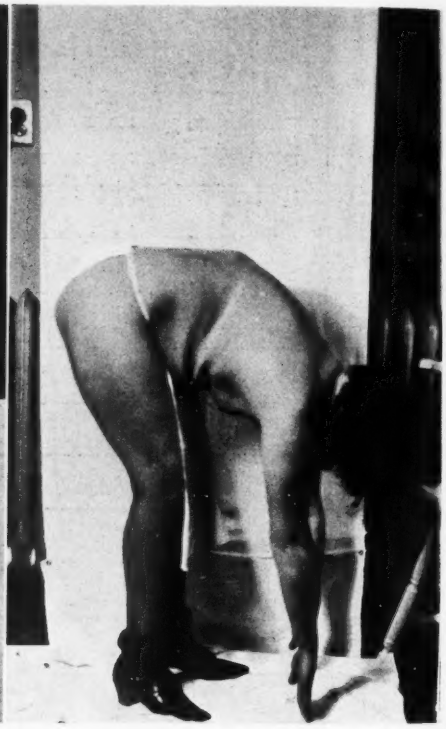


Fig. 3. Same case as shown in Figure 2, two years and four months later, showing nutrition and motion.

cases, has convinced us of the justification of the use of sunlight in the treatment of pulmonary cases, with the exception of those whose condition contra-indicates its employment. From our observations we have concluded that hemoptysis and other unfavorable reactions such as temperature, reactivation of the disease, etc., reported by adverse authorities, are not likely to occur, provided that proper precautions are taken and the details of the technic are carefully adhered to. We admit that there are cases in which its use is contra-indicated, such as those with marked activity or with generalized tuberculosis. We certainly would not consider it prudent to place a pulmonary case under sun-cure while having a hemorrhage—nor until two or three weeks after the hemorrhage has ceased. But in other cases, heliotherapy forms a most favorable addition to the régime usually prescribed for pulmonary tuberculosis. Particularly striking results have been obtained with sunlight in hydro- and pyo-pneumothorax cases, either spontaneous or following artificial pneumothorax.

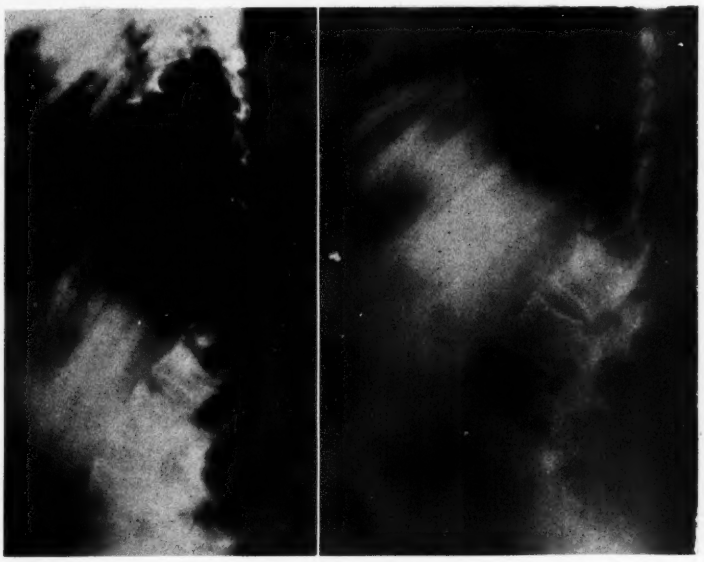


Fig. 4. Case No. 4090 (see Figs. 2 and 3). X-ray plate taken on admission.

Fig. 5. Same case, two years and four months later, showing fusion of bone.

Man, with his scientific and artistic proclivities, is forever busy wresting Nature's secrets from her, and then striving to imitate or improve upon her methods. Thus it came about that, as soon as Rollier's method of heliotherapy began to gain recognition in Europe and America, various kinds of lamps, producing artificial light for the treatment of disease, began to appear on the market. In the last few years, the varieties have become so numerous and the claims of their manufacturers have become so insis-

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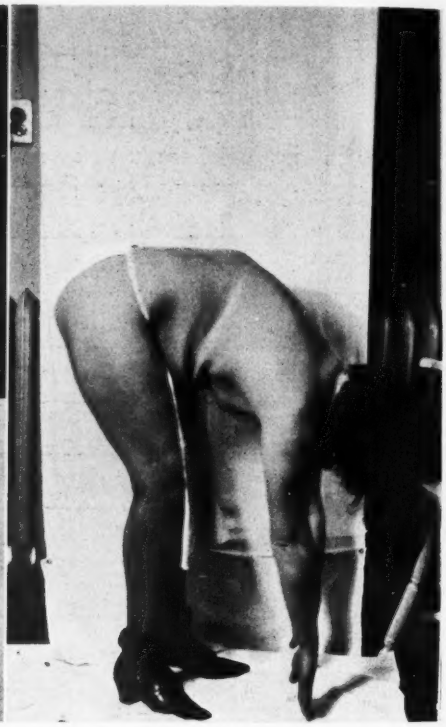

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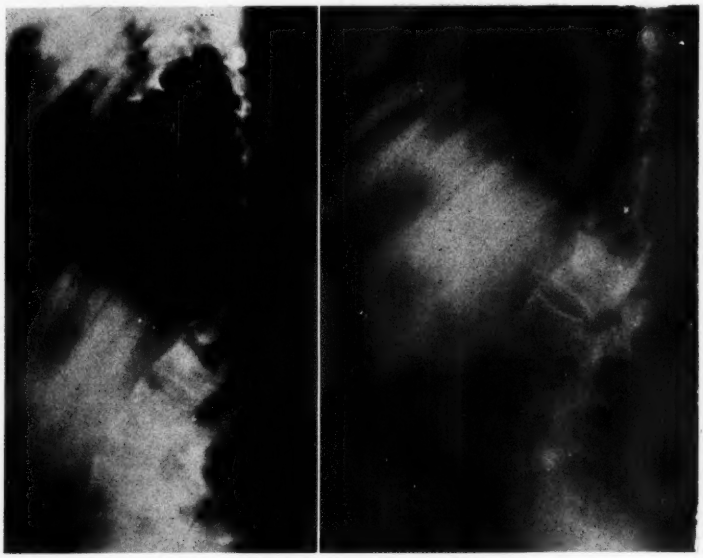

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tent and extravagant that every physician finds himself confronted with the necessity of looking into the matter for himself. Hence, the relative advantages of artificial light and natural sunlight become a timely topic for discussion.

The medical literature of the day discloses that additional therapeutic uses for light are constantly being discovered. It is probably true that in the treatment of some diseases certain portions of the spectrum are especially effective—one might almost say "specifically" effective. In such cases it is conceivable that artificial lights particularly strong in those portions of the spectrum might be equal or superior to natural sunlight. But I am speaking now of the relative value of natural and artificial light in tuberculosis only. This is the field in which most of my observations have been made and in which I feel justified in expressing an opinion.

The conclusions arrived at after fourteen years' observation of heliotherapy and various other forms of light treatment can be summed up by saying that Nature is hard to beat at her own game. None of the artificial lights so far produced commercially have seriously rivalled the sun itself in the treatment of tuberculosis. As things now stand, to discard heliotherapy in favor of lamps would be as illogical as to shut out the light of a bright noonday and work by electric light. We do not base our belief merely on casual observation, but on careful examination of the patient's condition before and after the course of treatment. A good tan may be obtained, but the skin lacks the velvety smoothness and suppleness that one notes in skins tanned by the sun. There is not the muscle development with the artificial light that there is with sunlight. However, in seasons when heliotherapy is impracticable owing to clouded skies or lowered air temperature, artificial lights satisfy a real need and their use at these seasons is to be recommended.

Most of the lamps employed belong to one of two types, the mercury vapor and the carbon arc. The spectrum of the light from the mercury vapor lamp being somewhat rich in ultra-violet rays, this type has attained considerable popularity among those persons who entertain the widely prevalent idea that the active healing principle lies in the actinic portion of the spectrum alone. This same theory has given rise to the idea that sunlight at a high altitude is more efficacious than sunlight near the sea level, because of its greater proportion of ultra-violet rays. But, to the best of our knowledge, this special effectiveness of the actinic rays has never been adequately proven so far as tuberculosis is concerned; it remains merely an unsubstantiated theory, which we do not wish to deny but which we are not willing to accept without demonstration. Lacking scientific proof, we are compelled to fall back on our experience, which has furnished ample evidence of the greatly superior results obtained by the employment of natural sunlight.

One cogent reason for the superiority of sun-cure over lamp treatment may be found in the very nature of the disease under consideration. For tuberculosis, although it may be manifested by lesions in many different parts of the body, is *not* a disease of the part manifestly affected, but of the whole system. For this reason, the aim of the

physician must be to build up the patient's general physical condition by placing him in an environment where the conditions of hygienic living will be met. In what better way can this be accomplished than by heliotherapy, which presupposes either a course of treatment in a sanatorium or the duplication of sanatorium conditions in the patient's home?

Fig. 6. Case No. 3300, on admission. Tuberculosis of left knee joint with subluxation, showing deformity.

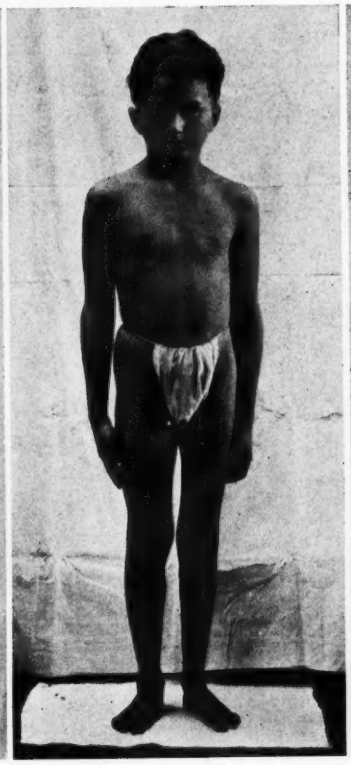

Fig. 7. Same case as shown in Figure 6, two years later, showing nutrition and correction of deformity.

Fig. 8. Same case as shown in Figures 6 and 7, showing degree of motion, and a gain in weight of 8 pounds. This case of tuberculosis was proven by animal inoculation.

Perhaps in our enthusiasm over sun-cure we have attributed too much virtue to the light itself, and too little to the other health-promoting agents connected with it. This error has given a loophole for the insidious suggestion that all the patient need do to get well is to sit or lie for an hour or two each day under the rays of the lamp, and then spend the rest of the time as he pleases. We should be only too glad if this were true. It would greatly simplify the treatment of tuberculosis by eliminating the necessity for long periods of enforced idleness, so irksome and financially embarrassing. But facts have too often proved it to be a fatal delusion. Without the tonic effect of moving air on the naked body, regular hours, suitable diet, and, above all, *rest*, light rays are robbed of much of their beneficial

action. The patient's time is wasted and his disease advances to a stage where a cure is very difficult.

About November, when the inclemencies of our northern climate begin to interfere with the successful application of heliotherapy, we turn to the lamp as a temporary substitute. While we have obtained some results with the types of carbon arc commercially available, these results have fallen so far short of those obtained with sunlight that our physicist, Dr. Brian O'Brien, has devoted considerable study to the problem of developing a light-source producing a close approach to sunlight. Very considerable progress has been made with this, and the results are encouraging. The mechanical and other difficulties have been such, however, that a final form of the apparatus has not been settled upon. Arrangement is made for treating about twenty adult patients at a time in one group in a well ventilated room.

Fig. 9. Lateral radiograph of Case 3300 (see Figs. 6-8), showing condition on admission.

Fig. 10. Lateral radiograph of Case 3300, taken two years later than Figure 9.

In an effort to more nearly approach sun-cure conditions, we at first tried opening the doors and windows, but the rooms became too drafty. We are still old-fashioned enough to believe that a cold wind striking the warm, naked body of the patient may be detrimental to his health. Now, instead of open windows, we have a ventilating device that keeps the air of the lamp-room reasonably pure. We shall not be perfectly satisfied until we have attained our ideal aim, which is to duplicate exactly heliotherapeutic conditions.

Many inquiries have recently been made regarding the use of varieties of glass which are claimed by their manufacturers to be transparent to the complete range of the sun's spectrum. Several of these glasses, tested by our physicist, were found to be all that was claimed for them. They would doubtless prove a great boon in the practice of heliotherapy in those localities where bright sunlight is frequently accompanied by high winds, low temperatures, or both. Throughout the eastern third of the United States, however, sunlight that is intense enough for heliotherapy is rarely seen except when the weather is such that the average tuberculous patient may be safely exposed with only ordinary wind protection. For very young infants or for patients who are exceedingly weak and ill, inclosures of these glasses would prove useful even in our climate.

As for the matter of using these glasses for the windows of schoolrooms, hospitals, dwellings, etc., I would hesitate to endorse it without in the same breath adding a warning against a false sense of hygienic security that might result therefrom. I refer to the danger of neglecting ventilation. The lack of sunlight and the lack of fresh air are twin evils, of which it would be difficult to choose the lesser. But if windows and doors are still thrown open whenever possible, or if some other adequate means of ventilation is provided, these special glasses would probably prove sufficiently beneficial to justify the added expense.

Up to January 1, 1927, there have been discharged from the J. N. Adam Memorial Hospital 1,169 patients who presented some form of extra-pulmonary tuberculosis or other condition for which heliotherapy was applied and who had remained in the institution three months or longer.

Of these cases,

524, or 44.8 per cent, were tuberculosis of the lymph nodes
112, or 10.4 per cent, were tuberculosis of the peritoneum
355, or 30.3 per cent, were tuberculosis of bones and joints
49, or 4.3 per cent, were osteomyelitis (non-tuberculous)
49, or 4.3 per cent, were tuberculosis of kidneys
17, or 1.5 per cent, were tuberculosis of epididymis
28, or 2.4 per cent, were tuberculosis of eyes
5, or 0.4 per cent, were tuberculosis of skin
17, or 1.5 per cent, with empyema (non-tuberculous)

Of the 524 cases of tuberculosis of lymph nodes,

432, or 82.5 per cent, were discharged as apparently recovered
51, or 9.7 per cent, were discharged as arrested
29, or 5.5 per cent, were discharged as improved
7, or 1.3 per cent, were discharged as unimproved
5, or 0.1 per cent, died.

Of the 112 cases of tuberculosis of the peritoneum,

85, or 75.8 per cent, were discharged as apparently recovered
14, or 12.5 per cent, were discharged as arrested
5, or 4.5 per cent, were discharged as improved
8, or 7.1 per cent, were discharged as unimproved

Of the 355 cases of tuberculosis of bones and joints,
198, or 55.8 per cent, were discharged as apparently recovered
85, or 23.9 per cent, were discharged as arrested
34, or 9 per cent, were discharged as improved
24, or 6.8 per cent, were discharged as unimproved
14, or 4 per cent, died.

Of the 49 cases of tuberculosis of the kidneys,
9, or 18.3 per cent, were discharged as apparently recovered
20, or 40.8 per cent, were discharged as arrested
14, or 28.6 per cent, were discharged as improved
4, or 8.2 per cent, were discharged as unimproved
2, or 4.1 per cent, died.

Of the 49 cases of osteomyelitis (non-tuberculous),
26, or 53 per cent, were discharged as apparently recovered
10, or 20.4 per cent, were discharged as arrested
11, or 22.5 per cent, were discharged as improved
2, or 4.1 per cent, were discharged as unimproved

Of the 17 cases of tuberculosis of the epididymis,
6, or 35.3 per cent, were discharged as apparently recovered
5, or 29.4 per cent, were discharged as arrested
5, or 29.4 per cent, were discharged as improved
1, or 5.9 per cent, died.

Of the 28 cases of tuberculosis of the eyes,
20, or 71.4 per cent, were discharged as apparently recovered
1, or 3.6 per cent, was discharged as arrested
4, or 14.2 per cent, were discharged as improved
2, or 7.1 per cent, were discharged as unimproved
1, or 3.6 per cent, died.

Of the 5 cases of tuberculosis of the skin,
2, or 80 per cent, were discharged as apparently recovered
1, or 20 per cent, was discharged as arrested

Of the 17 cases of empyema (non-tuberculous),
9, or 53 per cent, were discharged as apparently recovered
6, or 35.3 per cent, were discharged as improved
1, or 5.8 per cent, was discharged as unimproved
1, or 5.8 per cent, died.

The above figures do not include 50 cases of pyo-pneumothorax and 125 cases of pleurisy with effusion complicating either pulmonary or surgical tuberculosis that were treated with solar radiation. The results in these cases, especially where the pulmonary lesion was not severe, were most gratifying. Of the number that died, the cause of death of three was influenza during the epidemic, while in one case a psoas abscess ruptured into the intestines, causing death in a few days. The remainder were cases of sev-

RESULTS OF TREATMENT OF CASES THAT WERE DISCHARGED FROM

THE J. N. ADAM MEMORIAL HOSPITAL

UP TO JAN. 1, 1927, AND WHO HAD REMAINED IN THE INSTITUTION THREE MONTHS OR LONGER

Diagnosis	Total		Apparent Recovery		Arrested		Improved		Unimproved		Dead	
Tuberculosis of												
Lymph Nodes	524	44.8 %	432	82.5%	51	9.7%	29	5.5%	7	1.3%	5	.95%
Peritoneum	112	10.4 %	85	75.8%	14	12.5%	5	4.5%	8	7.1%	0	
Spine	94	8.04%	35	37.2%	27	28.7%	12	12.7%	15	15.9%	5	5.3 %
Hip	95	8.12%	59	62.1%	17	17.9%	12	12.6%	5	5.3%	2	2.1 %
Sacro-iliac Joint	7	.58%	4	57.2%	2	28.6%	0		0		1	14.3 %
Knee	49	4.19%	26	53.1%	12	24.5%	5	1 %	3	6.2%	3	6.2 %
Ankle and Foot	34	2.9 %	26	76.5%	6	17.6%	2	5.9%	0		0	
Wrist and Hand	30	2.6 %	20	66.6%	6	20. %	1	3.3%	1	3.3%	2	6.6 %
Humerus	1	.08%	0		1	100. %	0		0		0	
Femur	5	.43%	2	40 %	2	40. %	1	20. %	0		0	
Ischium	1	.08%	1	100. %	0		0		0		0	
Sternum	3	.24%	2	66.6%	1	33.3%	0		0		0	
Kidneys	49	4.29%	9	18.3%	20	40.8%	14	28.6%	4	8.2%	2	4.1 %
Epididymis	17	1.45%	6	35.3%	5	29.4%	5	29.4%	0		1	5.9 %
Eyes	28	2.39%	20	71.4%	1	3.6%	4	14.2%	2	7.1%	1	3.6 %
Jaw	1	.08%	1	100. %	0		0		0		0	
Shoulder	9	.77%	2	22.2%	6	66.6%	1	11.1%	0		0	
Elbow	12	1.02%	7	58.2%	5	41.8%	0		0		0	
Sacrum	2	.16%	1	50. %	0		0		0		1	50. %
Phalanges	12	1.02%	12	100. %	0		0		0		0	
Ovary	1	.08%	1	100. %	0		0		0		0	
Salpinges	1	.08%	0		1	100. %	0		0		0	
Osteomyelitis (non-tuberculous)	49	4.29%	26	53. %	10	20.4%	11	22.5%	2	4.1%	0	
Lupus and Tuberculous Ulcers	5	.43%	4	80. %	1	20. %	0		0		0	
Empyema (non-tuberculous)	17	1.45%	9	53. %	0		6	35.3%	1	5.8%	1	5.8 %
Perthes' Disease	2	.16%	2	100. %	0		0		0		0	
Rickets	9	.77%	9	100. %	0		0		0		0	
Total	1,169	100. %	801	68.5%	188	16.1%	108	9.3%	48	4.1%	24	2.1 %
Tuberculosis of Lymph Nodes	524	44.8%	432	82.5%	51	9.7%	29	5.5%	7	1.3%	5	.1%
Tuberculosis of Peritoneum	112	10.4%	85	75.8%	14	12.5%	5	4.5%	8	7.1%	0	0 %
Tuberculosis of Bone and Joints	355	30.3%	198	55.8%	85	23.9%	34	9. %	24	6.8%	14	4. %
Tuberculosis of Kidneys	49	4.3%	9	18.3%	20	40.8%	14	28.6%	4	8.2%	2	4.1%
Osteomyelitis (non-tuberculous)	49	4.3%	26	53. %	10	20.4%	11	22.5%	2	4.1%	0	0 %
Tuberculosis of Epididymis	17	1.5%	6	35.3%	5	29.4%	5	29.4%	0	0 %	1	5.9%
Tuberculosis of Eyes	28	2.8%	20	71.4%	1	3.6%	4	14.2%	2	7.1%	1	3.6%
Tuberculosis of Skin	5	.4%	4	80. %	1	20. %	0	0 %	0	0 %	0	0 %
Empyema (non-tuberculous)	17	1.5%	9	53. %	6	35.3%	0	0 %	1	5.8%	1	5.8%

eral years' standing with advanced pulmonary tuberculosis.

Fourteen per cent of the adults and 21 per cent of the children discharged had multiple lesions.

Fifty per cent of the adults and 27 per cent of the children had had surgical interference.

Seventy-six per cent of the adults and 16 per cent of the children had a diagnosable pulmonary lesion.

The average duration of illness before admission was about two and one-half years.

The figures in the table on page 227 do not include 50 cases of pyo-pneumothorax and 125 cases of pleurisy with effusion complicating either pulmonary or surgical tuberculosis that were treated with solar radiation. The results in these cases, especially where the pulmonary lesion was not severe, were most gratifying.

No patient who has been confined to bed is discharged as apparently recovered until he has been up and about for at least six months if the lesion is in a bone or joint, or three months in case of other lesions. As a rule, no bone or joint case becomes ambulant until X-ray examination shows good repair, all signs and symptoms have disappeared, sinuses and ulcers are healed, and abscesses have been absorbed or calcified. The patient being in this favorable condition and feeling correspondingly well, the three to six months' probation period taxes his patience to the uttermost, and in all too many cases he is induced by his restlessness to leave the institution before the proper time, with the result that our percentage of apparent recoveries is appreciably reduced.

CONCLUSIONS

In closing, three points require special emphasis:

1. In treating tuberculosis, artificial light should be resorted to only when natural sunlight is not available.

2. Lamps, when used, should be of the type most nearly resembling the sun in the intensity and spectral composition of their light.

3. Lamp treatments are to be employed only in conjunction with the usual regimen prescribed for the tuberculous.

Regarding the Influence of Beta Rays on Carcinoma. L. Farmer Loeb and Marie Wreschner. Strahlentherapie, 1927, XXVII, 487.

Starting from the fact that beta rays are very effective biologically, the authors studied the effect of the injection of a uranium preparation into tumors. A suspension of activated iron hydroxide particles was used in isotonic solution. The particles are not absorbed but remain at the place of injection and emit primary electrons. Experiments carried out on normal mice, rats, and rabbits did not show any injurious effect of the injections. Carcinoma (Flexner-Jobling) in rats was favorably influenced by the injection. The preparation was also tried in man, suffering from cancer. The therapeutic results seemed to be encouraging.

E. A. POHLE, M.D.

Stones in Prostates and Seminal Vesicles. John L. White. Tex. State Jour. Med., January, 1928, p. 581.

In cases of prostatitis which do not respond to the usual methods of treatment, X-ray examination should be made. Many such cases will show stones in prostate or seminal vesicles. The X-ray examination may miss some stones here, just as it does in other parts of the urinary tract, but stones are usually detected by this means.

W. WARNER WATKINS, M.D.

RADIOSENSITIVITY AND TUMOR MORPHOLOGY[1]

By LEILA CHARLTON KNOX, M.D.,
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TO judge of the advantages of treating a patient with radiation is often a more complicated problem than is presented by surgery. In surgery the question is: Can the tumor be completely removed; if it cannot, is any form of palliative operation advisable, and, if so, what? On the other hand, with radiation there are three problems to be solved for each person. One is the amount and quality of the radiation; the others, the situation and sensitivity of the tumor. It is obviously useless to subject patients to large doses of radiation when the tumor is of a type so highly resistant that little can be expected from treatments which must be dangerous in order to be effective. The factor of measurement of quantity is now fairly well settled. Complete tables exist for the percentage penetration of X-rays and gamma rays into the tissues, but the question of dosage as applied to a given morphological picture is still a matter of discussion.

A few of the more obvious facts concerning sensitivity have long been known, such as the great difference between basal and squamous cell epitheliomata of the skin, and the impossibility of affecting tumors of the stomach favorably by external radiation. But other fields are still problematical and at the present time considerable effort is being made to correlate the morphology of tumors with their sensitiveness to radiation. Such an understanding is clinically most important, as patients should be spared ineffective or too heavy radiation if lighter doses will be as useful, and it is even more unjust perhaps to treat too lightly tumors which will yield only to maximum doses.

Radiation sensitivity, as generally used, has hitherto often suggested two points of view, at times somewhat confused. One is mathematical and implies some precise method which will record this biological quality of the cells; the other is clinical and is estimated only by the temporary disappearance of tumor masses and ultimately by the duration of life of the treated patient. For this reason a vast amount of inaccuracy has crept into nearly all discussions and it is most important to remember in which sense the words are used. It is the object of this paper to review our knowledge of the subject and to collect such correlations as exist between the morphology of cells and the probability of destructive influences being exerted upon them by radiation, rather than to predict the survival or death of the patients who may possess such tumors. Optimism has led some to assume that a radiosensitive tumor implies a cured patient, but this is very frequently a wholly impossible conclusion. Certain tumors, locally removable by surgery but rapidly fatal with or without operation, have an unfortunate tendency to behave in the same fashion when treated by radiation. As it is unjust to evaluate results of surgery of any tumor without regard to the size and duration of the mass, the extent of operation, the existence of distant metastases, as well as the cellular morphology, so we must consistently distinguish between tumor sensitivity and the associated conditions which may or may not contribute to a probable cure of the disease if the neoplasm is subjected to radiation.

In the study of the sensitiveness of tumors to radiation, the only important experimental investigations are those done by

[1]Read before the Radiological Society of North America, at the Thirteenth Annual Meeting, at New Orleans, Nov. 29, 1927.

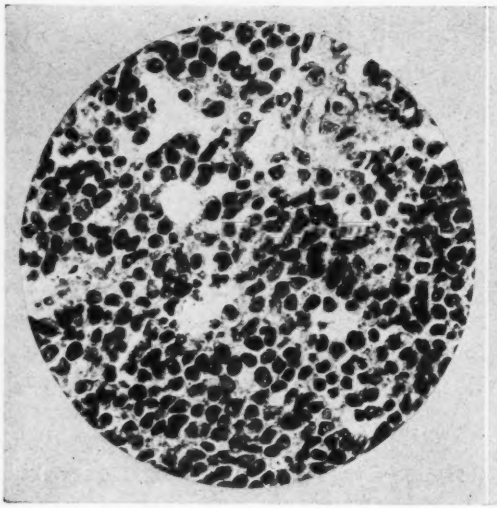

Fig. 1. Metastatic epithelioma from tumor of submaxillary duct. The cells show little differentiation and are usually radiosensitive.

Fig. 2. Photomicrograph of a differentiated type of breast carcinoma with long clinical history. This tumor is highly radiosensitive.

Wood and Prime at the Institute of Cancer Research of Columbia University, working with varying filtrations and also with X-rays of different qualities on a large variety of animal tumors, both *in vivo* and *in vitro*. Fragments of tumors were rayed and then re-injected into animals to test the viability of the cells. These experiments showed very clearly that in these animal tumors unexpectedly large doses of radiation were required to kill all the cells of the tumor, and that, when the sensitivity of the tumor was measured accurately, there were considerable variations between the growths of exactly the same morphology, not only in carcinoma but also sarcoma. In the discussion of these results considerable confusion has arisen for two reasons: one was that practical workers did not realize that the facts reported were obtained with complete elimination of scattered radiation in order that the result might be easily reproducible. For, as is well known, the amount of back-scatter varies with the wave length. Secondly, the practical radiation therapeutist was at that time unwilling to acknowledge that the doses which he was able to give to human beings rarely resulted in the destruction of all the cells of the tumor. For it was not realized that, in order to produce a clinical cure, it was by no means necessary to destroy all the cancer cells. Such destruction can rarely be accomplished except in strictly localized tumors by the insertion of large quantities of radium. Since these results were published, however, those working with combinations of X-ray and radium have greatly increased their doses, and one of the chief critics of the early work on animals sees in his own institution radiation doses administered which are five times those published by Wood and Prime as the lethal dose for the average animal tumor. On the other hand, as the sensitivity of the human tumor cannot be judged by transplantation into another human being, it is not always possible to say whether the metastases which develop after radiation of a human tumor were pre-existent or are due to cells which have escaped the destructive ac-

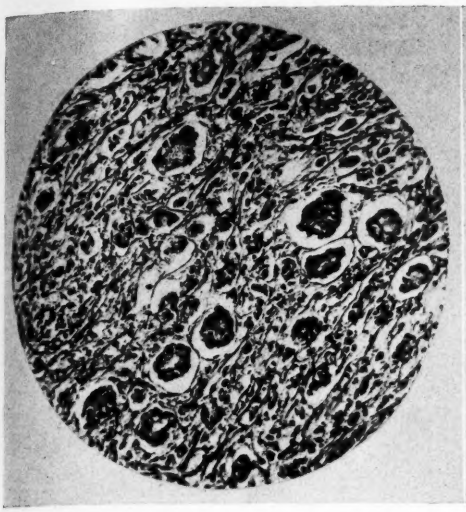

Fig. 3. Photomicrograph of one of the metastases of tumor shown in Figure 3. Section is from an axillary node.

Fig. 4. Photomicrograph of a radiosensitive breast carcinoma in which there is definite and nearly constant alveolar arrangement of epithelial cells.

tion of the radiation locally applied. There is thus additional confusion between cure and sensitivity, a distinction which does not exist when animal tumors are used.

The literature contains many estimates regarding the sensitivity of so-called normal tissues, these lists usually beginning with the cells of the sex glands and the lymphoid tissue and ending with bone and cartilage. The skin, which varies so greatly, quickly takes on pathological sensitiveness in certain diseases, as hyperthyroidism, whether because of altered vascularity or for more obscure physiological reasons, it is at present impossible to state. In such instances we have an illustration of the fact that morphology may be of no help in estimating a destructive dose, for the morphological differences in two such skin surfaces are negligible, the cell structures being practically the same and the vasomotor changes invisible in sections.

The variable results reported by different authors who have radiated ulcerated and infected tumors may be partially explained by these altered physiological conditions extraneous to the tumor morphology, and, if so, would be an important cause of variations in statistical results.

Explanations for the variability of the disappearance of tumor masses, when subjected to radiation, have been sought for within and outside of the tumor cell. The alleged protective effect of increased stroma, of round cells in the stroma, of hyaline changes present in the beginning or induced directly or indirectly by the radiations, the possible protective effect of mucoid stroma or mucoid secretions of the cells, and, most important of all, the swelling of the endothelium of the vessels and the resulting thrombosis and secondary necrosis of the tumor, have been called upon to explain or predict the effects of X-ray upon the tumor as a whole. Special interest attaches to the highly vascular tumors because of their many thin-walled sinuses and the ease with which these may be thrombosed. Morphologically, however, the very vascular tumors are often the most cellular also, and the ef-

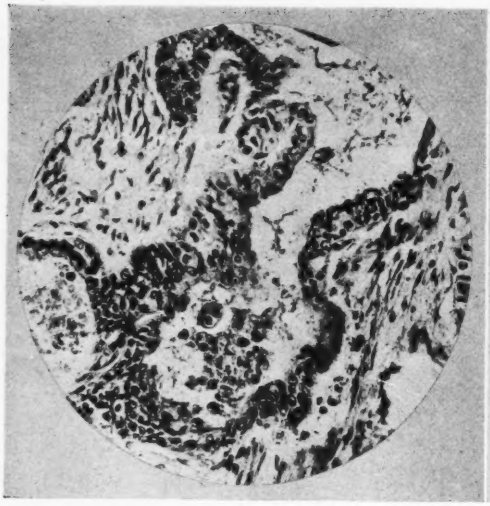

Fig. 5. Photomicrograph of an adenocarcinoma of the breast. This tumor is probably radiosensitive and is highly differentiated.

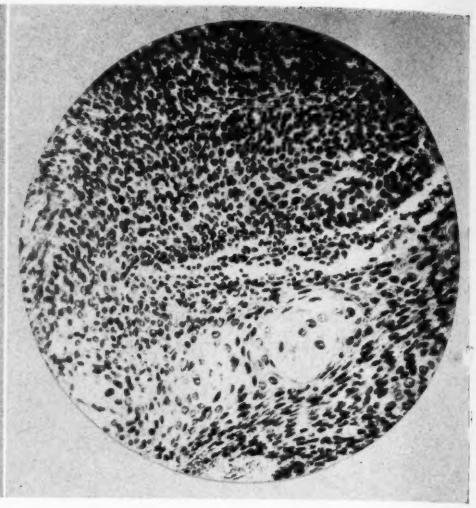

Fig. 6. Photomicrograph of a radiosensitive epithelioma of the cervix. The tumor is largely of the basal cell type but shows slight keratinization.

fects on the tumor nuclei are blended clinically with those on blood vessels.

Within the tumor cells the chief interest centers about four points: the origin of the cells, the degree of cellularity and the nucleo-cytoplasmic ratio, and, more especially, the degree of differentiation and the mitotic figures.

Béclère emphasizes the importance of the clinically observed fact that tumors derived from vulnerable cells are themselves vulnerable. For example, the sex cells are the most sensitive to radiation of the mature body cells; so also, embryomata of the testis are highly susceptible. As lymph nodes may be affected by light doses of radiation, so are their derivatives, leukemic and lymphosarcomatous nodes, even more highly susceptible. As the cells of the supporting tissues are able to withstand large amounts of radiation, so are the gliomata, and many others, though not all, of the cells of the central nervous system very refractory.

There are, however, striking differences in the sensitiveness of tumors arising in any one organ, as, for example, those of the testis, which show great fluctuation. The homogeneous cellular carcinomata, often designated seminomata, are very sensitive, while those of the more irregular type, probably derived from embryonal epithelium and with a morphological tendency toward the formation of irregular glandular structures, although with large nuclei and often numerous mitoses, are very resistant and frequently yield scarcely at all to large doses of radiation.

The more highly differentiated teratomata with mature tissue, such as cartilage, cysts with cylindrical epithelial lining, epidermis, and other mature tissues, are extremely resistant but may run a comparatively benign clinical course, unless the metastasizing fraction happens to be of high malignancy, as, for example, chorio-epithelioma. It is, therefore, not only the ancestry and inherited character of the cells, if such they are, which are of importance, but other biological differences exist which may be of even greater importance in attempting to

prognosticate radiosensitiveness. The principle of judging radiosensitiveness by the derivation of a tissue is strongly stressed by Ewing and others and is regarded by them as one of the more important criteria.

Of the morphological details, differentiation is important. Cellularity and the amount of nuclear material in proportion to the cytoplasm is of minor importance in some situations but is a feature closely related to differentiation, since many of the more mature and specialized cells are also larger and possess more cytoplasm in proportion to the nuclei. This applies perhaps most clearly in the case of breast tumors derived from the duct epithelium, carcinomatous cysts and papillary carcinomata, as well as the carcinomata of the rectum and to some of the squamous tumors, as in the cervix uteri.

The question of mitotic figures is at the present time regarded by several investigators as of supreme importance. Hansemann stated that only "old" cells—that is, those sufficiently mature to divide—could show radiation effects. Régaud, Lacassagne, and Béclère adhere strongly to this theory and expect to influence only dividing cells. For this reason fractional doses on successive days are by them believed to be most effective because such nuclei as have reached the metaphase and are, therefore, most susceptible may be destroyed and fresh generations of cells may be killed at each subsequent radiation.

There is also a widespread belief that mitotic figures are an index to malignancy. The form of the figure, whether normal or atypical, must undoubtedly be considered in this case, as, after radiation, atypical forms are certainly increased for a short time, as has been shown in clinical work by Schwartz, who made ten successive biopsies on a basal cell epithelioma of the cheek after erythema doses. It was earlier shown experimentally by Mottram, Bardeen, Holthusen, and Packard that X-ray can produce atypical mitotic figures.

On the other hand, mitotic figures of unusual size and regularity are extremely numerous in certain of the carcinomatous cysts of the breast which are of the lowest malignancy, and it is also open to question whether any one fragment of a tumor at any particular time exhibits mitotic figures which are constant for that tumor and which may properly be considered as an index of its aggressiveness and rapidity of growth as a whole.

Palugyay, with this in mind, made a special survey of 147 cases of cervical carcinoma in an attempt to correlate the mitotic figures with the degree of malignancy and he believes that there are perhaps more prophases in the undifferentiated and more malignant types of carcinoma in this region and fewer of the large mitotic figures of the later phases. If this is true, such tumors should be theoretically more easily affected by radiation.

Radiosensitivity, therefore, is a question not only of histogenesis but also of morphology and the weight of opinion is in favor of the fact that the degree of differentiation of the tumor cells is of very great importance. This is brought out in a study of tumors derived from squamous epithelium. In the lip it has been shown by Broders, who studied 537 cases of epithelioma of the lip, that the differentiation of the cells is a definite guide in surgical prognosis. This is obviously due to the fact that metastases are sufficiently retarded to insure a cure by local excision in a large number of cases, but less differentiated cells much more quickly penetrate to the lymphatics and involvement of the cervical nodes may be so widespread as to prove entirely intractable and outside the realm of surgical cure.

The radiosensitivity of these tumors apparently follows somewhat the same curve, as the more benign types are the more easily

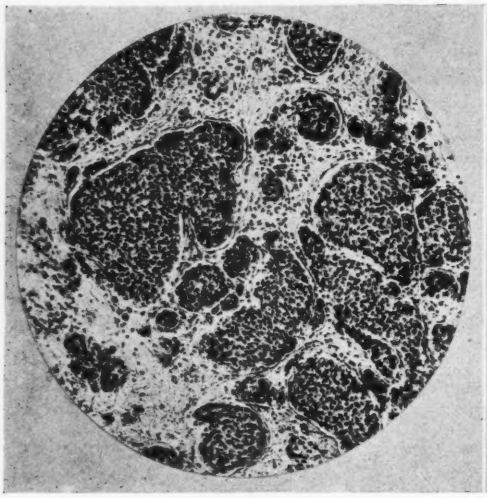

Fig. 7. Photomicrograph of a radiosensitive cervical carcinoma probably primary in the thyroid.

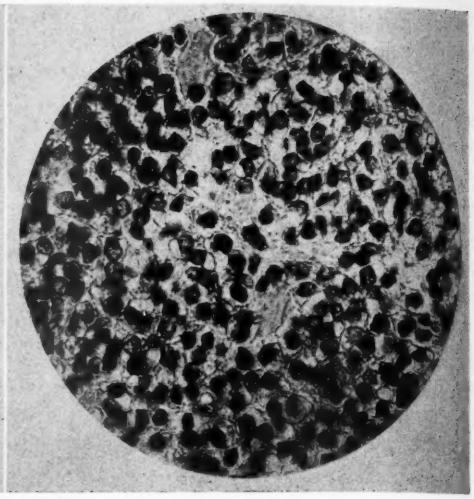

Fig. 8. Photomicrograph of a radiosensitive sarcoma or endothelioma of the scapula.

cured. On the other hand, Schmincke, and, more recently, Quick and Cutler, have described a highly sensitive tumor derived from the buccal or tonsillar epithelium showing only the very slightest tendency toward keratinization, and not infrequently called a reticulum cell sarcoma, which is clinically often more rapidly fatal because of the greater frequency of distant metastasis than is true of the more differentiated tumors. Such a tumor we have recently seen appearing as a large mass in the cervical region before any focus could be detected in the mouth, although careful search for the same was made because the metastasis was obviously of squamous origin as seen by very slight keratinization in scattered areas. The primary focus eventually appeared, growing out through the submaxillary duct. Such tumors disappear with relatively small doses of radiation, and their peculiar morphology, with large nuclei, scanty cytoplasm, and scarcely any associated tissue stroma, permits a fairly definite prognosis as to their susceptibility to radiation. (See Fig. 1.)

In the skin as a whole we are accustomed to recognize basal cell types of epithelioma, squamous types and intermediate or mixed types. It is occasionally stated, as by Régaud, that the curability is the same for each type, though the requisite dose varies. It is the experience of a great number of authorities that the basal cell tumors, without any suggestion of pearls, are the more readily cured and are frequently even highly susceptible, and that resistant tumors when examined microscopically almost invariably show small keratinizing areas, if not well formed pearls.

The melanomata are almost universally regarded as highly resistant and many authorities believe that it is futile even to attempt palliation by radiation. But there are very rarely small cell types of this tumor which are susceptible, although the elongated cell forms, roughly suggesting sarcomata, are highly resistant. Miescher observed one of the sensitive tumors which disappeared for a year under the influence of moderate radiation.

In the case of the breast tumors, an extensive study of morphology as applied to surgical cure was made by MacCarty on a large number of cases. He believes it possible to correlate morphology with the

surgical prognosis. Greenough studied 72 cases from the Massachusetts General Hospital and came to much the same conclusion, although differing from MacCarty in that he found the appearance and quantity of the stroma and the cellular exudate in it to be of no help in prognosis. The highest number of cures was obtained in patients possessing the larger cells, with fewer mitoses, relatively large nuclei and with vacuoles in the cytoplasm—a finding interpreted as an attempt toward secretion and therefore indicating a differentiated type of cell. Definite glandular arrangement was also regarded as indicating low malignancy. Following the same lines, attempts have been made to predict the radiosensitivity of breast carcinomata, but, as so few of the primary breast neoplasms are radiated, most of our opinions on the subject are derived from a morphological investigation of recurrences, and it is often possible that recurrences do not represent the exact morphology of the primary tumor. In general, it appears that the more differentiated carcinomata of the breast are more easily influenced by radiation. (See Figs. 2 and 3.)

Such a breast tumor, which showed itself extremely susceptible to sub-erythema doses of X-ray, is here seen to possess partially formed glands and many alveolar arrangements. Another tumor, found to be also highly susceptible, eventually metastasized by way of the lymphatics into the other breast and the morphology of the latter is shown here (Fig. 4). The lymphatics are, of course, widely dilated, due to the obstruction, but the epithelial groups tend with fair regularity to form partial acini. This tumor has run an extremely benign course extending over nineteen years. A single sub-erythemal dose of X-ray has many times caused a complete disappearance of the recurring nodules of this tumor in various portions of the body.

A third example (Fig. 5) is a portion of a breast tumor of the type of an adenocarcinoma, originally considered benign because of the marked development of the glands and the scanty infiltration, so that the axillary nodes were not excised. A recurrence in the skin, which is shown in the illustration, was later removed, indicating that the tumor was of a malignant type. There have been no further recurrences, but the patient has been repeatedly radiated and has been under observation for nine years, so it is hardly conceivable that any remaining cell groups have not been destroyed by the radiation.

The question of the carcinomata of the cervix uteri is perhaps the most interesting and important because of the extensive and increasing use of radium in treating these tumors. In the surgical field many attempts have been made to correlate morphology with prognosis, as by Cullen, Lubarsch, Martzloff, and Plaut. Martzloff and Plaut differ on this subject, Martzloff finding that, of 203 cases operated upon, 47 per cent of the highly differentiated squamous tumors were cured for five years by operation, while only 9.5 per cent of the least differentiated type (by him designated "fat spindle cells") were cured. A third group, intermediate in morphology and in prognosis, is also made. The author does not use the term "basal cell" but many of his less differentiated tumors would probably be so designated by other writers. Plaut, on the other hand, in a review of the morphology of 149 cases at the Woman's Hospital, New York, found that it was impossible to predict the surgical prognosis from the microscopic sections.

As radiation statistics are now becoming available, the same comparative studies of morphology and prognosis are to some extent a guide to sensitiveness, and many authors are reporting upon considerable series of cases both in Europe and in this country, but with conflicting opinions.

Authors generally divide tumors of the cervix uteri into two major classes, the col-

umnar cell carcinoma of the cervical canal, and, in the second group, several grades of epidermoid carcinoma. This classification is followed by Régaud, Cordua and others who attempt to grade sensitivity and morphology with great accuracy.

In general, there is agreement that the glandular types are highly malignant and will not respond to radiation. Adler, Lahm, Rost, Proust, and Régaud believe that this type is almost never cured, but even here opinions also differ, as Bagot and Oppert state that such tumors are not necessarily completely refractory and that cures have occurred with radium treatment. Schmitz also ranks them intermediate in radiosensitivity between the basal and the squamous type.

With regard to the squamous types, some authors recognize two and some four subdivisions. Adler studied 190 cases and Cordua classified the microscopic sections on 40 more radiated cases. Their findings are exactly opposite to the findings of the American observers but agree with Régaud's later conclusions that the highest percentage of cures is in the most differentiated squamous cell types with many pearls.

Kimbrough and Norris have reported on 120 cases also, and although the findings of these authors differ from the European statistics in that they believe that the basal cell tumors, even though infiltrating more deeply, are still more radiosensitive, they also clearly state that the stage of the disease is of greater importance in prognosis than the histology of the tumor. This important clinical fact may account for the findings of Cordua, whose report is based on only 40 cases, since most of the patients presenting themselves in the Kiel Klinic were operated upon unless the disease was very extensive.

An example of a clinically sensitive epithelioma of the cervix is shown in Figure 6. This tumor, although very advanced and inoperable, occurring in a middle-aged Italian woman with a huge ulcerated crater involving the whole cervix, has been arrested now for seven years by the insertion into the uterine cavity of a single tube of 60 milligrams of radium. It is probably in this type of tumor that we are to see the highest percentage of radiation cures. The fact that it is the highly differentiated cell types which are in the uterus the most resistant to radiation is illustrated again in the case of the adenocarcinomata as they occur in the fundus. It is almost universally acknowledged that the more glandular, branching, papillary types, with fewer medullary areas, are more resistant than the medullary non-acinous form.

Of the other squamous tumors, those in the larynx are important owing to the extreme mutilation caused by surgical therapy. The radiation results have been very discouraging heretofore, but, if the suitable type for radiation can be selected by morphology, this is a fact of capital importance. It is believed by Régaud and Lacassagne that the tumors arising in the true vocal cords are of a more differentiated type, with keratinization and pearls, and that these are distinctly radioresistant, while those arising in the false cords and in the sinuses are more sensitive, and can be treated by massive radiation, with a highly complicated special technic.

The morphology in this situation can be more readily determined than is possible in the case of the esophageal tumors, as biopsies, laryngoscopy, and even laryngotomy offer a better means of judging of the morphology of the tumor as a whole. In the esophagus the diagnosis usually has to be made from a very minute fragment and the tumor is never clearly viewed before treatment. For this reason there are no facts of importance concerning this very helpless group.

Thyroid carcinomata are generally acknowledged to be fairly sensitive to radiation. This is based not upon morphology

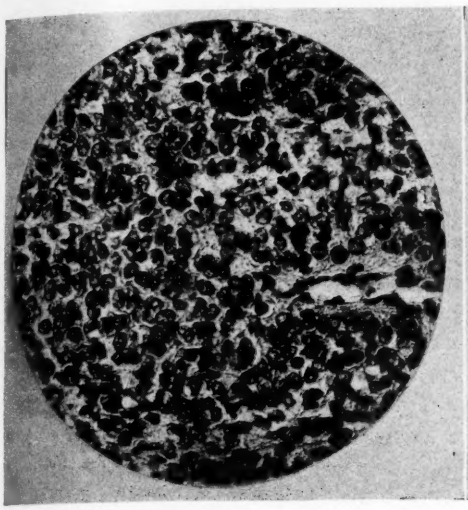

Fig. 9. Photomicrograph of a radiosensitive sarcoma or endothelioma of the ilium.

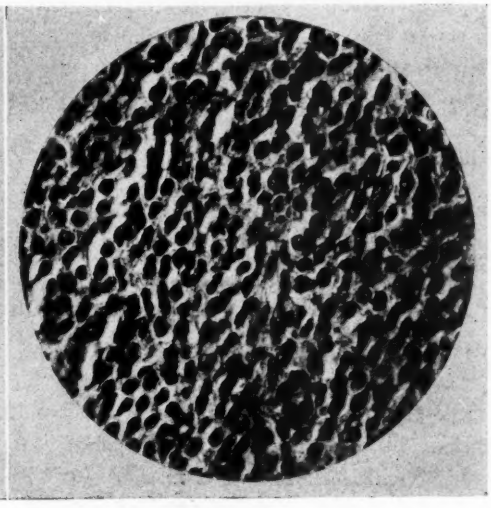

Fig. 10. Photomicrograph of a radioresistant sarcoma of the cervical fascia.

but is an example of the importance of histogenesis. Such a tumor is seen in Figure 7. This growth recurred in the cervical region immediately after operation, but dis appeared completely under the influence of lead and heavy radiation.

There is almost universal agreement that the lymphosarcomata are, if limited to a single group of nodes, capable of being destroyed completely by moderate doses of X-ray, bringing about very rarely a clinical cure. With regard to the other sarcomata, there remains a great deal of uncertainty. The most sensitive are probably a group of tumors described recently by Ewing and designated by him endotheliomata of bone, although formerly classed as sarcomata. These growths are highly vascular, tending to grow around the blood vessels, sometimes only in the proximity of fairly large sinuses, so scant is the stroma. The nuclei vary. Some tumors possess uniformly large ones, usually polyhedral, while others are distinctly small and regular. The small cell type is shown in Figure 8. This tumor disappeared rapidly under radiation, although involving the scapula extensively and forming a large mass. The patient remained free from tumor and apparently well for over a year.

But another sarcoma, now under observation in our clinic, is shown in Figure 9. This would no doubt be classed as an endothelioma by some pathologists, possibly as a periosteal sarcoma or a fascial sarcoma by others. Its sensitivity to X-ray has been very great and the tumor disappeared rapidly. It arose from the inner surface of the ilium, from which it was inseparable although showing no involvement of bone in radiographs. The iliacus muscle was lifted up by it. A very large tumor mass was left *in situ* at the operation, but the patient is still apparently well and free from tumor after two and a half years. In this way the tumor resembles the endotheliomata more than either the osteogenic sarcomata or the osteo-chondro-sarcoma type, which are admitted by all to be very resistant. The presence of cartilage and extensive new neoplastic bone, even in the presence of many connective tissue nuclei of less differentiated type, and giant cells, indicates that a tumor is scarcely in the field of the radiotherapist.

Destructive and degenerative changes may occur in both bone and cartilage but the cellular portion of the tumor continues to proliferate.

The cystic giant cell tumors of bone, containing endothelial giant cells and granulation tissue, behave more like Hodgkin's disease and other granulomata, but the morphological picture here may be a very misleading one, and, despite erythema doses of short wave length X-ray even over accessible tumors in the extremities, may continue to extend and destroy the cortical bone with increasing pain and disability to the patient.

Fascial sarcomata are particularly difficult to treat with success. This may be due to the fact that morphological details are overlooked, as Ewing emphasizes the fact that many of these tumors are neurogenic in origin and behave like the tumors of the subcutaneous tissues, which are known to be derivatives of neural elements, and are highly resistant. But the more cellular of these tumors closely resemble other fascial sarcomata which are moderately sensitive to radiation. Figure 10 represents a section from a large superficial spindle cell tumor entirely uninfluenced by heavy radiation. This field is one in which more morphological studies should be carried out. The number of such tumors seen in a general hospital is insufficient to form a basis for generalization, and collected studies have not yet appeared in the literature.

Many other groups of tumors, such as those of the gastro-intestinal tract, salivary regions, bladder, prostate, and brain, have not been included because of lack of sufficient personal or published material from which to draw final conclusions. A curious exception to all rules are the rapidly increasing group of primary pulmonary neoplasms which show a varied morphology, including glandular, mucoid and epidermoid varieties, and yet all types are up to the present time completely resistant to our efforts.

CONCLUSIONS

1. Radiosensitivity is not to be confused with clinical cure, but is a term used only to designate the reaction of a tissue to radiation.

2. The attempts which are being made to correlate the morphological picture of a tumor with its radiosensitivity are of the utmost importance and should be extended as rapidly as possible.

3. Of the morphological characteristics, the degree of differentiation is probably the most important single feature in every situation. In the use of such morphological criteria as differentiation it must be remembered that what is true for one organ does not necessarily apply to another, as, for example, breast and uterus.

4. Other factors, the importance of which depends upon local conditions, are the size of cells, size and irregularity of nuclei, and the abundance of mitoses. Of less importance is the character of the stroma and its infiltrating cells.

5. There is no constant relationship between vascularity and sensitivity.

6. Sensitivity may be to a certain extent predicted from morphology of a tumor, but absolute exceptions to this rule are not infrequent. In treatment, morphology, though valuable, may be subordinate to histogenesis.

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The Roentgenotherapy of Basedow's Disease. Paul Krause. Strahlentherapie, 1927, XXVII, 393.

The author, who holds the chair of Internal Medicine at the University of Muenster (Germany), discusses the present status of roentgenotherapy in exophthalmic goiter. His indications, dose, and precautions to prevent injuries from over-exposures are essentially the same as arrived at in this country. He believes that surgery and radiotherapy are approximately of the same value. Study of the original paper is recommended.

E. A. POHLE, M.D.

Electrothermic Methods, Roentgen Rays, and Radium in the Treatment of Malignant Diseases of the Eye, Ear, Nose, and Throat. J. Thompson Stevens. Jour. Med. Soc. of N. J., February, 1928, p. 99.

This paper, written for a general medical body, describes the procedures used in handling malignancies of the eye, ear, nose, and throat. The technic of electrothermic methods and irradiation by radium and X-ray are described. Radiation is always indicated wherever and whenever a malignant process is found, no matter what other method is used in conjunction. The author uses the so-called "saturation method" of X-ray dosage, applying small doses of high voltage X-rays at short periods until a 100 per cent dose has been given, and then maintaining this saturation by subsequent irradiation for several weeks.

In carcinoma of the skin about the face electrothermic coagulation and radiation are used. In lip carcinoma, electrocoagulation and buried radium are used. In epithelioma of the skin of the auricle, electrothermic methods and radiation are indicated; if the cartilage is involved, removal of the auricle by electrocoagulation and radiation of the cervical lymphatics. Malignancies in the mouth are destroyed by electrocoagulation, followed by buried radium and frequently by X-ray.

W. WARNER WATKINS, M.D.

On the Effect of Roentgen Rays on Living Tissue in Vitro. R. Gassul. Strahlentherapie, 1927, XXVII, 545.

The author studied the biological effect of roentgen rays on explanted tissue. The spleen of frogs, erythrocytes, the mucous membrane (oscillation of cilia), and staining with carmeen were studied. Technic: 190 K.V., 3 Al. plus 0.5 Zn. or no filter, 23 to 30 cm. F.S.D., 1 to 75 minutes' exposure. Each effective dose causes regressive changes in both protoplasm and nucleus; only unfiltered rays under a certain dose affect the protoplasm alone. Within a certain range of energy applied to the tissues roentgen rays of different wave lengths seem to have a gradually different effect on protoplasm and nucleus.

E. A. POHLE, M.D.

ON THE VARIOUS TYPES OF DEXTROCARDIA AND THEIR DIAGNOSTICS[1]

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TRANSLATION BY I. SETH HIRSCH, M.D.

THE history of medicine is practically the history of its methods. By a systematic application of new methods of investigation ancient problems may not infrequently revive and acquire a new importance. This holds true for dextrocardia (or, at any rate, isolated dextrocardia), because of the introduction of the electrocardiographic and roentgenologic methods of examination.

The problem of the right-sided position of the heart has been but casually studied until the present day. This is due chiefly to the fact that the clinical reports of the few cases of dextrocardia which are scattered through the literature—old literature in particular—are mostly of no scientific value in the light of modern data. The cases subjected to postmortem examination are unfortunately few.

On the other hand, the combined examination by means of X-rays and electrocardiogram presents so complete and precise a picture in the living that it has become possible to differentiate and diagnose the various types of dextrocardia, which differ in principle from one another. On the basis of the data obtained we are able to suggest a practically new and convenient classification.

We understand by the term "dextrocardia," in the widest meaning of the term, any right-sided heart. Every case of dextrocardia is either (1) complicated, wherein there is, besides some defect in the development of the heart itself, a disturbance of the normal circulation, or (2) noncomplicated, wherein the cardiac valves, the septum, the origin of the great vessels, etc., are normal and the mechanism of circulation remains unmodified. The whole of the large group of dextrocardia we divide into two subgroups: (1) the congenital, and (2) the acquired dextrocardia. The first group includes *(a)* non-isolated dextrocardia, which is but a partial manifestation of a complete transposition of all viscera—situs inversus viscerum totalis—and (*b*) isolated dextrocardia, wherein all the viscera, particularly the abdominal, occupy a normal position. Two separate subdivisions may be distinguished in the isolated: (1), with inversion of the cavities of the heart, and (2) with normally placed cavities.

This report is based on the analysis of our own 37 cases. These include 22 cases of complete transposition of the viscera, 5 cases of congenital isolated dextrocardia, and 10 cases of acquired right-sided position of the heart.

DEXTROCARDIA IN COMPLETE TRANSPOSITION OF VISCERA

From the formal anatomical viewpoint this type is easily recognizable (Fig. 1). The normally developed internal organs occupy, as is well known, a reversed position and have reversed shapes. The apex of the heart is to the right, and the right arterial ventricle, from which the pulmonary artery takes its origin, is adjacent to the sternum. The aortic arch passes over the right bronchus and lies to the right of the vertebral column.

The diagnosis of situs inversus by means of the usual clinical examination presents no great difficulty. However, one should

[1]Report read in the Leningrad Roentgen-ray Society in March, 1927. From the State Institute of Roentgenology and Radiology and the First Therapeutical Clinic of the Graduate Institute in Leningrad, U. of S. S. R.

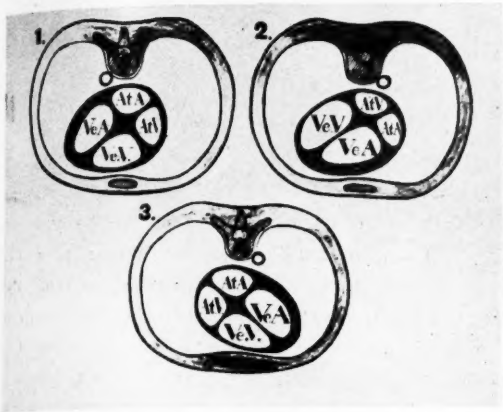

Fig. 1. (1) Position of the heart and its cavities, Types I and III. (2) Inversion of the cavities and aortic arch, Type II. (3) Normal interrelation of the cavities and aorta. At. V., venous auricle; At. A., arterial auricle; Ve. V., venous ventricle; Ve. A., arterial ventricle.

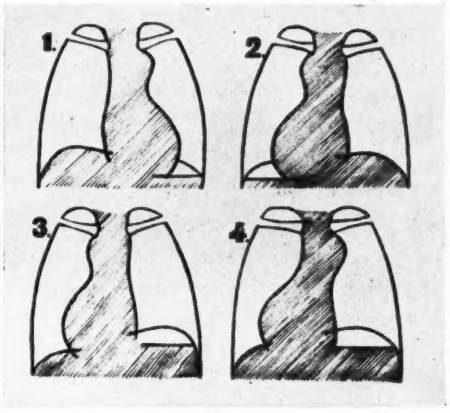

Fig. 2. X-ray appearance of the different types of congenital dextrocardia. (1) Normal. (2) Complete inversion of viscera (Type I). Reversed image compared with normal. (3) Congenital isolated dextrocardia with inversion of cavities. Abdominal viscera normally placed (Type II). (4) Isolated dextrocardia, with normal interrelation of cavities and left-sided aortic arch (Type III). Note the position of the diaphragmatic domes.

not limit the examination to auscultation in the usual places, as somewhat weakened heart sounds may also be heard in the region of the left nipple, a fact which sometimes gives rise to a faulty diagnosis of myocarditis, exudative pericarditis, etc. Some of our male patients had for this reason been dismissed from compulsory military service.

Among the physical symptoms the most important are the transposition of the percutory findings of the heart, the liver, and the spleen and of the tympanites of the stomach. In an asthenic constitution this may not be sufficiently clear, as we have had occasion to observe in two instances. The heart, in both those cases, was small and situated in an obliquely vertical position, and the diaphragm was low.

Further, reversed position of the apical impulse is also a characteristic symptom of congenital dextrocardia. According to our observations this symptom, however, is not constant in situs inversus, and, on the other hand, in acquired dextrocardia the impulse may also be felt over a limited space below the right nipple.

Because of the normal structure of the heart, as the great majority of the cases are non-complicated, no murmur is heard. In 10 cases we found a functional systolic murmur. In one case only was the murmur due to a defect in the septum.

The majority of our patients were young. The ages of the 10 males and 12 females varied between 9 and 50 years. There are no indications that inversion is inherited. The general development is normal in most of the patients. One patient uses equally well both his right and his left hand. Another patient of 50 considers himself to have been left-handed since his childhood. All the other patients are right-handed.[2] Among the 29 patients reported by LeWald there was not a single left-handed individual.

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[2]It is interesting to note that some of our patients felt the heart beating on the right and for this reason themselves suspected their heart to be situated on the right side.

Fig. 3. Congenital isolated dextrocardia, with normal interrelation of the cavities (Type III). The aortic arch passes on the left side as normal. Normal position of the abdominal viscera. Male, 36 years of age.

A certain point of importance in the diagnosis in male patients lies in the position of the testicle. Contrary to the usual rule, in the majority of cases of situs inversus the right testicle is lower than the left. Among our patients the symptom was positive in four cases and negative in three. In three cases it was not established.

The data obtained by roentgenologic and electrocardiographic examinations are of decisive importance. The typical picture of complete inversion revealed by roentgenoscopy is too well known to be discussed here in detail (Fig. 2). With regard to electrocardiograms (ecg.), it has been established by the investigations of Nicolai, Hoke, Samoilov, Zelenin and others that situs inversus is characterized by certain changes. In the first lead, the ecg. is always inverse. Lead II corresponds to the usual III, and III to the usual II. A reverse electrocardiogram is considered to be a sure sign of differentiation between the true inversion of the cavities and their normal position.

By studying the electrocardiograms of our patients taken in 6 leads, as well as by means of needles from the region of the heart, we can see typical changes. Only in two cases was the inverse electrocardiogram observed not only in Lead I but in II and IV as well. Such an occurrence has not as yet been mentioned in the literature. It might be supposed that here the transverse, not the longitudinal, position of the heart was also more pronounced in II as well as in Lead I, namely, the electric axis of the heart was in a more markedly transverse position than is usual and the apex was nearer the right arm than the lower extremities.

CONGENITAL ISOLATED DEXTROCARDIA

These are of the greatest interest and occur much less frequently than complete situs inversus. In 1918 Clerc and Bobrie selected from the literature 61 supposed cases; among them, in 23 instances, there existed simultaneously other defects of development. Electrocardiographically examined cases were first described in 1919 and 1920 (Weinberger, Vaquez, and Donzelot).

On the ground of the normal electrocardiogram and the few postmortem examinations (at present there are 19), the view has been accepted that isolated dextrocardia differs in principle from situs inversus (Weinberger, Vaquez and others). Indeed, until now, not a single anatomically verified case of a reverse position of the heart alone and a normal position of the abdominal viscera has been described. Therefore, a number of authors, as, for instance, Lochte and others, have denied the possibility of *situs inversus partialis*. At present, due to the most thor-

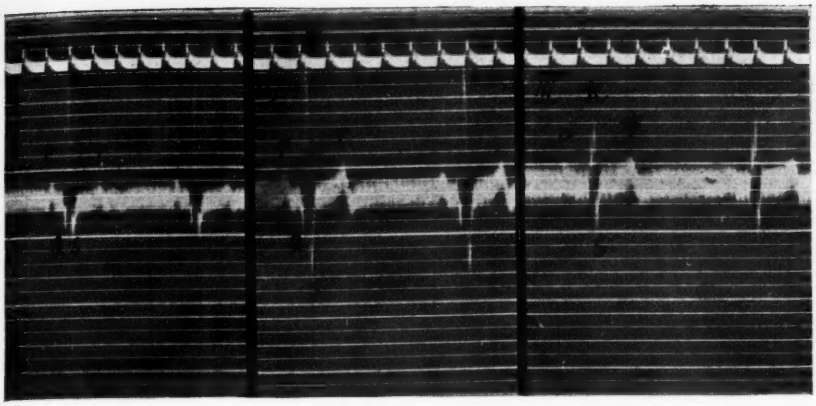

Fig. 4. Electrocardiogram of the case shown in Figure 3. Normal direction of the waves in all leads.

ough investigation carried out by Pernkopf, who has collected and classified the whole of the casuistical material on partial inversion, it may be considered as finally established that various organs and complexes of organs may occupy a reverse position, with a normal development of other organs; and, contrary to this, that in case of a general inversion of organs separate parts may develop abnormally. It must be noted also that there is an endless variety of forms; there are no two cases quite alike in their details.

The understanding of these various forms of isolated dextrocardia is still further complicated by their being closely connected with the most difficult problem, dealing with the so-called transposition of the large arterial trunks of the heart. As is known, in transposition of the large vessels the aorta is situated anteriorly, while the pulmonary artery is situated posteriorly; however, different variations may be observed (true transposition, corrected transposition, rotation of the ventricles with the apex directed to the right, etc.). In short, there may be every possible combination between the position of the point of origin of the larger blood vessels and the ventricles of the heart.

In most cases of isolated congenital dextrocardia the position on the right side is due to *the rotation of the normal heart* round the axis of the vertebral column from the right to the left, and is by no means a reverse image of the normal topographical picture (Fig. 1). The apex of the heart is formed by the right venous ventricle, which gives origin to the pulmonary artery; the left arterial ventricle, from which the aorta emerges, lies behind the sternum and is the anterior ventricle. As a rule, the aorta forms an arch over the left bronchus; its reversed position has been noted only in Grunmach's and Nagel's cases.

Among our five cases of congenital isolated dextrocardia, only three may be regarded as belonging to this type. The patient's general development in each case was normal and hypersthenic. This anomaly, which was not complicated in our cases by any other malformation, had no effect on the general health. The cardiac dullness was on the right; the impulse was felt in the region of the right nipple; the size of the heart was not above the normal. The sounds were pure, and best heard in the region of the right nipple. The second sound at the base was in one case more marked on the left, in another it was equal both on the right and on the left. The

Fig. 5. Congenital isolated dextrocardia, with inversion of cavities (Type II). Female, 40 years of age. Complete reversion of the heart shadow, aorta on the right side. Normal position of the liver and stomach.

roentgenograms revealed (Figs. 2 and 3) a reversed position of the heart, while the aorta, contrary to *situs inversus totalis*, formed an arch over the left bronchus and lay to the left of the vertebral column. Thus, the roentgen picture presented a mirror-like reflection of the well-known anomaly, in which a normally situated heart may be observed with a right-sided aorta (inversion of the aortic arch). The abdominal viscera presented no deviation from the normal as regards their position and shape.

The electrocardiogram (Fig. 4) differed markedly from the curves obtained in cases of situs inversus. All the waves preserved their normal direction and were the largest in the II lead. The only thing to be noted was the increase of the wave Q in the I, II, and III leads, also to be observed in acquired dextrocardia.

On the basis of all that has been said, it may be concluded that the inter-relation between the auricles and the ventricles of the heart remains normal and that the electric axis of the heart in these cases does not at all correspond to its roentgenologic axis.

It is usually possible to make the diagnosis of this type by means of the X-ray examination, as the position of the heart shadow on the right, and the shadow of the aorta (the arch and the descending part) on the left are most characteristic of this type of dextrocardia. The diagnosis becomes certain when the patient, besides being examined roentgenologically, is also subjected to electrocardiographic examination and the latter reveals a normal direction of the waves.

The other two cases of isolated congenital dextrocardia we have observed were of a quite *different type*. Both roentgenologically and electrocardiographically they presented precise copies of a complete transversion of the viscera as related to the thorax. The difference between the two cases was that in one instance, a girl, aged 14, there was a non-complicated anomaly of the position of the heart. The electrocardiogram was inverted in the I lead; the II lead corresponded to the usual III, and the III to the usual II. In the other instance, that of a woman, aged 40 (Fig. 5), there was apparently an inconsiderable defect of the septum, which caused no serious disturbances of circulation. In this case the electrocardiogram (Fig. 7) was mirror-like not only in the I lead, but in the II and IV as well. It is evident that here the axis of the heart had a more markedly transverse position than in the other cases (Fig. 6). We consequently see a complete analogy with similar cases of *situs inversus totalis*, which have been described above. The X-ray examination also revealed in this patient a very peculiar anomaly of the colon—the entire colon was situated in the right half of

the abdomen; the position of the duodenum was unaltered; the jejunum and ileum occupied the left side of the abdomen (non-rotation).

With regard to the clinical symptoms, the same may be said as has been stated in regard to situs inversus. It is interesting to note that in this case the right dome of the diaphragm is lower than the left—an indication that the height of the diaphragmatic dome is due to the heart and not the liver (Fig. 2).

All this leads us to accept the existence of an isolated dextrocardia with inversion of the cavities, a lesion not yet anatomically confirmed with precision. However, our cases are not unique in this respect. In 1923 Meyer described a case of "pure isolated dextrocardia" with a reversion of the electric axis of the heart. In the literature for 1925 there are three other cases reported by Capon and Chamberlain, LeWald and Blumenfeldt, which, however, are not described in detail. The clinical examination apparently is more advanced in this respect than the anatomic.

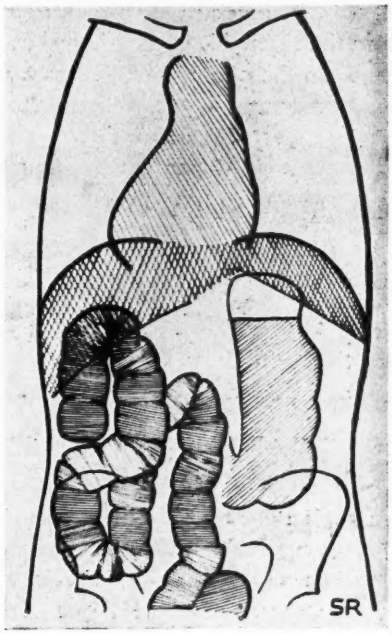

Fig. 6. Position of colon in the case shown in Figure 5. Non-rotation of the colon in the inversed sense (on the right side). Mesenterium commune. Position and shape of the duodenum normal.

ACQUIRED DEXTROCARDIA

This group stands entirely apart. It is not unfrequently met with, both in the clinic and in postmortem examination, and is of no particular interest from the viewpoint of pathogenesis. Among the cases of acquired dextrocardia we noted ten wherein a marked displacement of the heart was observed, the latter occupying in the right half of the chest an analogous position to that usually observed in the left. Apparently the axis of the heart is also rotated to the right in these cases, and, owing to this, they bear a great likeness to congenital dextrocardia with no inversion. From this viewpoint their roentgenologic and electrocardiologic study should certainly be of some interest.

The picture of the displacement of the heart varies on a very large scale, depending on the nature of the essential pathologic condition. Usually the other organs of the mediastinum are displaced, together with the heart.

The causes producing acquired dextrocardia are varied. In our cases it was mostly caused by retracting lesions of the right lung, the pleura, and the pericardium.

Clinically, we observed in all cases the dullness of the heart on the right, and in most cases it reached beyond the right nipple and could hardly be differentiated from the dullness in the region of the right lung. The apical impulse was felt in part of the cases over a limited field in the region of the right nipple or lateral to it, and differed from the impulse in congenital dextrocardia only by its immobility on the patient's changing

position. In other cases a diffused pulsation in the right side of the thorax was observed. In the majority of the cases a systolic murmur was heard, either at the apex or at the base. The accent on the second sound was not infrequently noted to the right of the sternum in the second intercostal space. The sounds of the heart were best heard in the right half of the thorax. The external shape of the thorax proved to be unmodified in most cases.

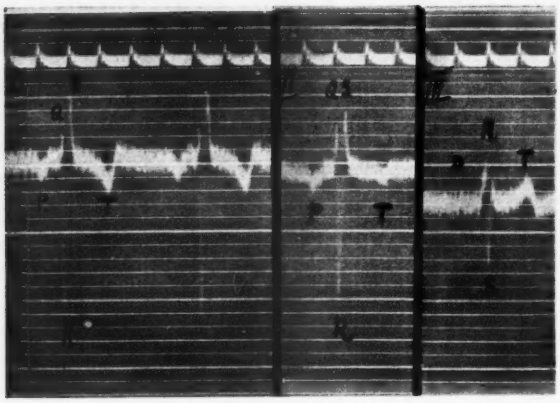

Fig. 7. Electrocardiogram of the case shown in Figures 5 and 6. Inversion of all waves in the I lead. Interchange of leads II and III.

Acquired dextrocardia is best diagnosed by roentgenologic examination. In some cases it is possible not only to establish the displacement of the heart to the right, but its rotation around the axis from the left to the right and anteriorly as well. Usually the right contour is lost in the shadow of the right lung field. The aortic arch pulsates to the left of the vertebral column. The esophagus forms a curve with the convexity directed forward and to the left. The electrocardiographic waves are always directed as normal; the only characteristic modification is an increase in Wave Q, mostly only in the I lead. In the same lead Wave P is sometimes very small or shows a double phase. The other leads present nothing abnormal. Thus in acquired dextrocardia we always find, of course, a normal interrelation of the heart cavities.

Cases of the right-sided position of the heart, which form a transitory group between congenital and acquired dextrocardia, should also be attributed to this type. Such are the dextrocardiæ which are observed in congenital diaphragmatic hernia, agenesia of the right lung, etc. (Figs. 8 and 9). Though dextrocardia in such cases is congenital, it is, nevertheless, caused by pathologic changes of the adjoining organs and does not differ in principle from displacements of the heart acquired after birth. We have observed two similar cases in infants with enormous left-sided diaphragmatic hernia.

THE ORIGIN OF CONGENITAL DEXTROCARDIA

This problem is yet but little advanced. Doubtless, however, the various types of dextrocardia are essentially very different conditions and arise at various developmental periods. Marchand long ago noted that the causes of a complete and of a partial inversion are different, but what those

causes are still remains unknown, notwithstanding the numerous attempts to solve this problem experimentally. *Situs inversus totalis* arises earliest. According to Moenckeberg, the rotation of the heart to the right takes place not later than the twelfth to the fifteenth day of embryonal development. Isolated dextrocardia develops later. In Type II the growth of the heart apparently occurs as in situs inversus; in Type III, the changes producing the displacement of the heart to the right develop still later. According to Nagel, this occurs during the sixth week of development, this type presenting something like a fixed phase of embryonal development.

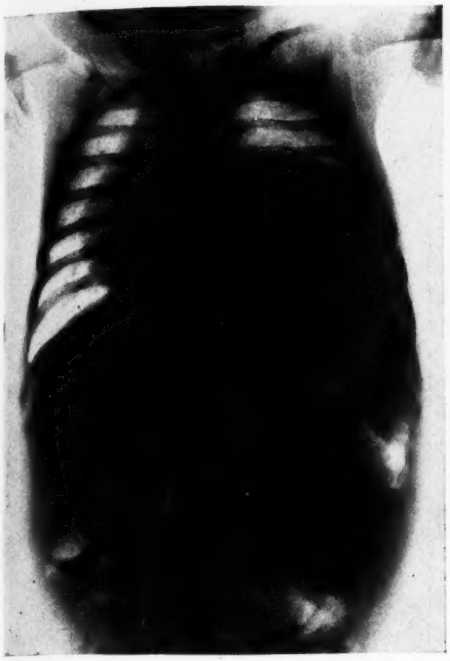

Fig. 8. Displacement of the heart to the right side by congenital diaphragmatic hernia (Type IV). Supine position. Male, aged 6 months.

CONCLUSIONS

I. Four types of dextrocardia should be distinguished:

1. Dextrocardia in *situs viscerum inversus totalis* (Type I), characterized by a reversed roentgen image and an inverse electrocardiogram in the I lead (rarely in the II lead as well).

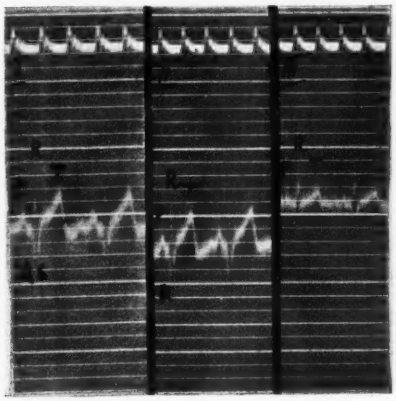

Fig. 9. Electrocardiogram of the case shown in Figure 8. Normal direction of the waves. Increase in Wave Q.

2. Isolated congenital dextrocardia with inversion of the heart cavities (Type II), characterized by a reversed position of the heart and the aorta, but a normal position of the abdominal viscera, and by an inversion of the electrocardiographic waves.

3. Isolated congenital dextrocardia, with a normal interrelation of cavities (Type III), in which the heart is situated on the right, the aorta passes over the left bronchus, the abdominal viscera are normally placed, and the electrocardiogram is normal.

4. Acquired dextrocardia (Type IV), which is characterized by the same peculiarities as Type III and pathologic changes of some of the adjoining organs.

II. Combined roentgenologic and electrocardiographic examination is decisive for the differentiation of various types of dextrocardia.

III. The position of the diaphragmatic domes is due to the position of the heart

CLASSIFICATION AND DIFFERENTIAL DIAGNOSIS OF THE DIFFERENT TYPES OF DEXTROCARDIA

Type	Name	Position of cavities of the heart	Position of aortic arch	Position of abdominal viscera	X-ray picture	Electrocardiogram
			A.—Congenital Dextrocardia			
I	Dextrocardia in complete transposition of the viscera.	Inversion	Passes the right bronchus	Inversion	Complete mirror-like image.	Inversion of all waves in I lead, sometimes also in II.
II	Congenital isolated dextrocardia with inversion of the cardiac cavities.	Inversion	Passes the right (or seldom the left) bronchus	Normal (anomalies possible)	The heart shadow at right; the abdominal viscera normal.	Inversion in I lead; possible inversion in the other leads (II and III)
III	Congenital isolated dextrocardia with normal interrelation of the cardiac cavities.	Normal	Passes the left (or seldom the right) bronchus.	Normal	The heart shadow at right; the aortic arch at left; normal picture of the abdominal viscera.	Normal
			B.—Acquired Dextrocardia			
IV	Acquired dextrocardia	Normal	Passes the left bronchus	Normal	The heart shadow at right; pathologic condition in some thoracic or abdominal viscera.	Normal

and not the liver. That side of the diaphragm on which the heart rests is lower.

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THE INTERNIST AND RADIOLOGY[1]

By J. H. MUSSER, M.D., NEW ORLEANS

From the Department of Medicine, School of Medicine, Tulane University of Louisiana

NATURALLY, it is with a certain trepidation that an internist ventures to address such a scientific body as this, concerned, as it chiefly is, with a specialty far afield from the routine endeavors of the practitioner of medicine. The daily work of the medical man concerns itself much with roentgenology; in fact, more and more continuously, but this contact between internist and radiologist is hazy and indefinite. It consists largely of the blind acceptance by the internist of the statements of the roentgenologist as to the proper diagnosis of films, and concerns itself not at all with thoughts of technic or details of method. It is for this reason, then, that I hesitate to venture to express to the members of an organization like the Radiological Society of North America my concepts and ideas about a highly specialized branch of medicine. On the other hand, because of this very fact—the high degree of specialization of your branch of medicine, together with the more or less isolation of the roentgenologic specialty, removed from close contact with medicine, as the internist views his profession—it might be well for me to discuss the limitations of roentgenology as they appear to the medical man as a diagnostic method solely, and dismiss from consideration any mention of radiotherapy.

Bear in mind that the position of the roentgenologist in the world of medicine is rather anomalous. He is the only diagnostician in medicine who depends upon physical methods alone to gain his objective, in contrast to the man who must employ biologic and chemic, inductive and deductive measures in order to make an anatomic and functional diagnosis—an anatomic diagnosis which never attains the high degree of exactitude of that of the roentgenologist. He is the only diagnostician who depends solely on his eyes and does not have to call upon the auxiliary special senses, notably of touch and hearing. He is primarily a physicist, secondarily a physician, one who is by knowledge fitted to examine and to treat the sick. He is interested in the manifestation of disease as seen on a film and produced by physical methods, but not in the changes incident to disease that are observed and sensed when standing by the autopsy table.

These observations are trite and obvious. They are, for the most part, recognized and appreciated by the body roentgenologic, but they are not taken into consideration by the medical profession, which everywhere seems willing to accept the word of the radiologist as dogma and proven fact.

It seems to me that the share contributed by the roentgenologist toward furthering the misconception of the all-embracing authority of the roentgen film lies for the most part in his endeavor to make diagnoses, functional in character. The best example that we can mention is that observed in the usual report, such as is submitted after a complete gastro-intestinal examination. Such a report consists very largely of notations of variations from the so-called normal or physiologic standards. Yet the character of the radiologic examination of the gastro-intestinal tract is such that it is hard to conceive of any reason why this tract, delicately attuned as it is to the nervous system, should function normally. An unpalatable solution is first presented to the patient to be drunk. Unsavory, gustatory, and distasteful preparations profoundly affect the secretory and

[1]Read before the Radiological Society of North America, at the Thirteenth Annual Meeting, at New Orleans, Dec. 2, 1927.

motor function of the esophagus and stomach. Here starts the possibility of functional disturbance. Then the subject is led into a laboratory replete with weird and uncanny looking apparatus, familiar to you all and bereft of any disturbing features as a result of your daily association with these instruments, but to the patient they suggest legerdemain. Psychic influences also profoundly affect the gastro-intestinal tract; witness the cardiospasm of fear, rage, or anger, or, to express it in more homely words, the diarrhea of fright. Add to these, the effect of the ingested preparation locally. In a few minutes the emulsion or the material in which the opaque meal was given has gone, leaving a heavy, inert metal to be taken care of by an intestinal tract that has never felt the likes before, an inert substance which in immeasurably smaller amounts is known to affect the motor function of the intestines. This statement applies to barium as well as bismuth. Under circumstances such as these, it is with difficulty that I can grant even the slightest approach to normal conditions, without which it is impossible accurately or adequately to evaluate the functional response of the fickle and capricious gastro-intestinal tract. I will allow that the roentgen ray will demonstrate beautifully definite organic change, but I question the efficacy of the roentgenologic method in determining functional disturbances.

Turn to another phase of disturbed physiology—pathologic physiology, if you will—and let us observe the changes that are produced by disease. Let us take an example other than the one just used—the gastro-intestinal tract—and discuss that internal organ more frequently radiated by the roentgenologist at the request of the medical man than any other. In the lungs, disease produces organic change adequately and fully recognizable on the film. What we are most definitely and frequently concerned with is whether or not this pathology is producing symptoms at the time the roentgenologic examination is made. Are the shadows on the film indicative of present activity or are they markings left of an old pre-existent lesion which has become entirely quiescent, is the question which agitates the internist, and concerning which, unfortunately, the roentgenologist too frequently commits himself in the endeavor to express a definite opinion. Even with a full knowledge of the clinical facts and in consultation and co-operation with the clinician, without which aids all roentgenologists agree no attempt should be made to arrive at a diagnosis of pulmonary tuberculosis in the active stage, I doubt if such a diagnosis should ever be made unless serial films have been taken from time to time, showing progressive change in the area of involvement —an increase in the film shadows.

The examination of the mastoid cells is another type of study which may not primarily belong to the internist; rather, it may be assigned to the otolaryngologist. The internist, however, is frequently interested from the point of view of focal infection, of the possibility of a mastoiditis being responsible for a fever of unknown cause, or for some other reason he is anxious to know not only if there is mastoid involvement but also if the mastoid change, in case it is present, is active or quiescent. Here, again, as with the chest films, the medical man is too prone to depend upon the roentgenologist's interpretation of activity, an interpretation which is extremely difficult to make. Witness a patient who, on the basis of the diagnosis of chronic purulent mastoiditis, was operated upon. The surgeon found the "left mastoid cells occluded; all trabeculæ visible, but blurred; mastoid dry and sclerotic, showing old chronic lesion." Also, note the history of a patient with a running ear, who was kept for weeks without operation because the roentgenologist reported that the mastoid

involvement was the result of a previous infection and the present lesion was inactive. Most assuredly the physicians placed too much weight on the roentgenologic diagnosis of the presence or absence of infection.

There is another phase of pulmonary diagnosis that I should like to mention briefly in passing, namely, the diagnosis of pulmonary disease in the aged. In old individuals the passage of time, the repeated infections of the respiratory tract to which all individuals in a crowded community are subject, and the constant inhalation of coal dust, soot, and city dirt have a profound effect on the lungs. Invariably and inevitably, these factors are responsible for a marked increase in fibrous tissue throughout the lung, and, necessarily, tracheobronchial adenopathy. To the clinician, these emphysematous, bronchiectatic, and bronchial changes are as much a part and parcel of old age as are sclerosed arteries and refractive errors of the eye. By the roentgenologist, it has always seemed to me, these changes are not so clearly appreciated as they should be, and, because of the marked fibrotic change as revealed by the roentgen ray, a diagnosis is made of chronic fibroid phthisis. As with all roentgenologic diagnoses, this one is accepted in full by medical men as positive and definite proof of the existence of the disease, but it is a diagnosis which can not be substantiated at the autopsy table.

On the more recent innovations which have widened greatly your field of service, and more particularly cholecystography and bronchiography, I would like to say a word. It seems to me that these methods of getting opaque substances to certain portions of the body have a definite value in diagnosis, but just how great this value is, I do not think we know as yet. We do not know fully the limitations of the methods nor do we know the norm. One can not help but hear with scepticism a remark that 95 per cent of individuals with upper respiratory tract infections have dilatation of the bronchi, as determined by observations made after the intratracheal injection of iodized oil. It may be the truth, but I would be inclined to the view that the normal is not known. Roentgenologists appreciate that cholecystography is as yet too recently arrived in the field of study for them to draw an "exact line of demarcation between the anatomically normal and abnormal gall bladder," to quote from an abstract of a paper by Kirklin. The profession as a whole does not know this and yet they will cheerfully accept the diagnosis of gall-bladder disease from the roentgenologic standpoint.

I think that this talk might more fittingly have been addressed to a general medical meeting than to one devoted to roentgenology. You all know and are thoroughly familiar with what I have presented, but what I do not think you know or can begin to appreciate is the blind, unswerving, thoughtless belief in the infallibility of the roentgen ray by the medical profession as a whole. You know full well that barium in the colon retained over a certain period does not necessarily indicate clinical intestinal stasis, nor that linear shadows and mottling in certain areas of the chest field tell that the patient has active pulmonary tuberculosis. You know that, but your client, the physician, in most cases does not. Therefore, help him by full consultation, by explanation of the limitations of roentgenology, and by not-too-frequent positive diagnoses.

DISCUSSION

DR. P. M. HICKEY (Ann Arbor, Michigan): It is always instructive to have some one hold up a mirror and allow us to see how we really appear to others. We should take the words of the essayist seriously under consideration because there is so much truth in what he has said. Certainly we

ought to profit by the mirror which he has held up before us. In the teaching of roentgenology it is just as important to present to students the limitations of the X-ray as its usefulness. In some of the lectures given in medical colleges the instructor in roentgenology will show the student a series of successful diagnoses, while the limitations of the X-ray are not adequately presented, and so it follows when the student goes out from college he may have the idea that the X-ray is infallible in certain lines of diagnosis.

One point on which I should like to differ with the essayist is—if I quote him correctly—that the roentgenologist is a physicist first and a physician second. This is a wrong basis because a roentgenologist should be a physician first and a physicist second. If the roentgenologist begins his work with the idea that he is employing physical laws without regard to the clinical history of the case, he will sometimes be led astray just as the essayist has mentioned. Perhaps the most important consideration is that the roentgenologist should have inherent honesty in his makeup. He should have a definite realization of the responsibility which is placed upon him, and should not, in his anxiety to help toward a diagnosis, transcend the limits of that of which he is actually positive.

With regard to the question of cholecystography, I would like to quote from Dr. Graham, that he considers cholecystography, first of all, an indication of the function of the gall bladder and not primarily an indication of pathology of the gall bladder.

With regard to examination of the gastrointestinal tract by the X-ray, I feel that there is oftentimes just ground for criticism, and I agree with the essayist that the internist should scan the report of the gastric examination with a just evaluation of the experience and reliability of the roentgenologist who has made the report.

Dr. A. U. Desjardins (Rochester, Minnesota): I am glad Dr. Musser had the courage to come here and tell us exactly what he thinks about radiology and the radiologist. It is always good for the soul to see ourselves as others see us. It is quite true that many internists, especially the younger men, accept blindly any roentgenologic report that comes to them. Indeed, many seem to base their diagnoses largely on such reports. If I may be as candid as Dr. Musser, it is also true that many radiologists have lost contact with clinical medicine to such an extent that they live literally in a world of shadows. There is too great a tendency to base interpretation of roentgenograms on roentgenologic appearances alone, without regard to the clinical features of a case. There can be no question that the ability of the roentgenologist to interpret roentgenograms accurately, as well as the appearances seen on the fluoroscopic screen, depends on his knowledge of anatomy, pathology, physiology and on his training and experience in clinical medicine. Therefore, the value of roentgenologic opinion depends on the ability of the individual man, just as the diagnostic ability of the internist depends on his individual ability.

EDITORIAL

OSTEOPOROSIS IN EXOPHTHALMIC GOITER

While osteoporosis from non-use or senility or as an accompaniment of joint disease is commonly recognized by radiologists, it may not be unwise to call attention to other conditions which produce it. Not infrequently osteoporosis occurs as a diffuse, bilateral, and symmetrical process, such as is found in osteomalacia, yet little is understood of its true pathology.

Quite recently Aub,[1] of Boston, W. A. Plummer,[2] of the Mayo Clinic, and others have made studies of osteoporosis encountered in exophthalmic goiter. In this disease calcium is excreted excessively and in direct ratio to the rise of the metabolic rate. Unless compensated for by diet, the calcium excreted must come from the osseous system. Roentgenologically, the resulting osteoporosis is most readily demonstrable in the bones of the hand, but in advanced cases of exophthalmic goiter the osteoporosis seems to involve the entire skeleton, and may be so pronounced as to resemble osteomalacia or osteoclastic metastasis from malignant disease. In one case that was observed osteoporosis was general; the ribs, which were extremely porous, had multiple fractures, and the entire picture was strongly suggestive of metastasis. At necropsy the ribs could easily be crushed between the fingers, yet the extreme rarefaction was due wholly to absorption of lime salts, no cellular changes being demonstrable.

The radiographic changes can best be appreciated by making control exposures of corresponding bones of normal persons having approximately the same age and weight as the patient. For example, the hand of a patient with exophthalmic goiter and the hand of a normal control depicted by simultaneous exposure on the same film furnish a valid basis of comparison. If radiologists will make comparative studies of the bones as a routine in cases of exophthalmic goiter, and will make inquiry as to possible disorders of metabolism in cases of osteoporosis, further valuable information may be gained.

A. B. Moore, M.D.

1Aub, J. C., Heath, C. W., and Bauer, W.: Effect of Thyroid on Calcium Metabolism. Proc. Soc. Exper. Biol. and Med., 1926, XXIII, 699.

2Plummer, W. A., and Dunlap, H. F.: Cases Showing Osteoporosis Due to Decalcification in Exophthalmic Goiter. Proc. Staff Meetings Mayo Clin., 1928, III, 119.

SINE IRA ET STUDIO

To the Editor of Radiology:

Dear Sir: After a careful study of the communication of Dr. U. V. Portmann, of Cleveland, Ohio, concerning our paper on "Clinical and Physical Investigations of the Problem of Dosimetry in Roentgen Therapy," published on page 85 of the July, 1928, issue, we do not feel that we should go into a detailed reply, for three reasons. In the first place, it would practically amount to a complete analysis of the major part of our previously mentioned paper; in the second place, discussions of this type usually do not lead anywhere; last, not least, it is our sincere opinion that criticism of such a

nature ought to be backed up by the critic's own experimental data. In other words, our measurements should have been repeated. Dr. Portmann has not brought forward a single figure based on work of his own along these lines. Really, before he comes forth with a complete condemnation of our work, we suggest that results of measurements of his own be offered, and then we shall be glad to enter into a discussion. It is also obvious that some of the statements he made are not in agreement with the accepted physical principles of dosimetry.

While this refers to the discussion of the experimental data, the latter part of Dr. Portmann's communication enters into an argument dealing with plain facts. He has contradicted the account of the calibration of our Wulf Ionometer as given on pages 308 and 309 of our paper, and claims that "Dr. Glasser has made three attempts but has failed completely to calibrate the instrument." We do not know what makes Dr. Portmann doubt the truth of our statements, but in order to settle this matter beyond question, we have mailed a photograph of the protocol of standardization for our instrument, signed by Dr. Glasser, also an affidavit regarding the last calibration carried out in Cleveland with a radium check, to you, as Editor of RADIOLOGY, and also to the Chairman of the Committee on Standardization.

We regret immensely that we have to go into this discussion, which has been forced upon us. As much as we welcome a criticism concerning the experimental part of our paper, we feel that it is not justifiable to question the plain facts as stated in our publication.

Yours truly,

ERNST A. POHLE, M.D., PH.D.
JOHN M. BARNES, B.S., M.D.

Ann Arbor, Michigan
July 26, 1928.

THE 1928 CHICAGO MEETING

THE COMMERCIAL EXHIBIT

The Commercial Exhibit at the 1928 Chicago meeting is going to be the largest, most elaborate, most diversified, and most comprehensive one that has ever been brought together anywhere or at any time.

Applications for space began coming in during the early part of the year—months before any definite plans had been made—and we have assurance from manufacturers that they are going to make this their gala exhibit. It has always been the contention of your exhibit manager that a good Commercial Exhibit had great educational values, and that the visitors to the exhibit profited by visiting it as much as did the exhibitors, though perhaps in a different way. Because of these views, it has been our aim to induce the manufacturers to exhibit, by making the rental rates of the space within reasonable limits, and by extending to the exhibitors as many privileges and courtesies as we possibly could. Evidently the exhibitors have appreciated this, as practically all the space in the exhibit at New Orleans in 1927 was sold within two days after it was offered. This gratifying appreciation of our efforts has been an incentive to do better for the exhibitors each year, and we have for this, the 1928 meeting, the finest exhibit space that we have ever had. Blueprints will be mailed to all on our mailing lists, about October 1. Any firms who have not been receiving these may have same by applying to the undersigned. Laggards in selecting space are warned that

first come will be first served. The wise ones telegraph for space.

I. S. TROSTLER, M.D.
Manager of Commercial Exhibits and Transportation.
812 Marshall Field Annex, Chicago.

"CHICAGO'S GREATEST RADIOLOGICAL SESSION"

It is time to make plans to attend the Fourteenth Annual Meeting of the Radiological Society of North America, to be

View of Michigan Avenue double deck bridge at night, showing the Wrigley Buildings. In going from Chicago's "Loop" to the Drake Hotel one passes over this bridge.

held at the Drake Hotel, Chicago, December 3 to 7, inclusive, 1928. The hotel is located on North Michigan Avenue, a few minutes' ride from the Loop on a motor bus. There will be ample accommodation for all members and visitors at the hotel, if reservations are made in advance, but this matter of making a reservation is important and should not be neglected.

The usual railroad rate of full fare going and half-fare returning will obtain, with advantages from Western Canada which are new this year. Dr. Trostler will make full announcement of transportation matters before the date of the meeting.

The wives of all Chicago members are banded together into an efficient Ladies' Committee, and entertainment is assured. Strangers who wish to go about Chicago will find some one glad to direct or to accompany them. Newspaper stories to the contrary notwithstanding, human life is comparatively safe in Chicago.

The hotel rates were announced in the August issue of RADIOLOGY. Reservations should be made through Dr. Frank J. Ronayne, West Suburban Hospital, Chicago, Illinois, Chairman of the Hotel Committee. In case one prefers to make them direct with the Drake Hotel, be sure to mention that the reservation is to cover the meeting of the Radiological Society.

BOOK REVIEWS

ERGEBNISSE DER MEDIZINISCHEN STRAHLENFORSCHUNG (Röntgendiagnostik, Röntgen-, Radium-, und Lichttherapie). Herausgegeben von H. HOLFELDER, H. HOLTHUSEN, O. JUNGLING, und H. MARTIUS. Band III; 791 pages. Verlag von Georg Thieme, Leipzig, 1928. Price 68 marks.

Many who have read the first two volumes of this collection of selected monographs have looked forward to each succeeding number with increasing pleasure and anticipation. The editors responsible for this valuable publication deserve much praise for the excellence of their endeavors. It is to be regretted that the contents are not available to all American radiologists.

The third volume of this work comprises 791 pages and 613 illustrations. There are fifteen chapters, eleven of which concern roentgen diagnosis.

The roentgen diagnosis of the nose and accessory nasal cavities is discussed by Steurer, of Tübingen. Technic and the interpretation of normal and abnormal radiographs are considered. It is to be noted that the Waters position, so commonly used in this country, is apparently little employed in Steurer's clinic.

Steurer also contributes a most excellent article on the examination of the mastoid, containing many beautiful illustrations. He describes an interesting method of demonstrating cholesteatoma with lipiodol.

Schüller discusses the roentgen diagnosis of acoustic tumors, emphasizing local skull changes, dilatation of the internal acoustic meatus, and forward displacement of the dorsum sellæ. The same author discusses fractures of the petrous portion of the temporal bone.

The roentgen demonstration of the bronchi with contrast media is described by Brauer and Lorey, of Hamburg. This article contains many illustrations of normal and abnormal conditions.

Teschendorf contributes a most valuable monograph on the roentgen study of the esophagus. A practical description of the anatomy and physiology introduces the discussion of the normal and abnormal findings. This is without doubt one of the most valuable presentations of this subject obtainable.

Persistent elevation of the diaphragm is discussed by Dillon. The anatomy, physi-

ology, and etiology of this condition are described at some length.

Fleischner presents the roentgen diagnosis of intestinal tuberculosis. The photographs of the gross specimens add greatly to the value of this excellent article.

Gottheiner, of Berlin, discusses the roentgenology of appendicitis. The subject is commendably presented but it will not revive the interest of those who have long ago ceased to accuse this troublesome structure because of certain roentgen findings.

D'Amato, of Hamburg, presents a general review of the roentgen diagnosis of cholecystitis, especially emphasizing cholecystography. The article is comprehensive and includes sections on the anatomy and physiology of the gall bladder, various methods of cholecystography, and the interpretation of cholecystographic shadows. This is one of the best résumés of the subject obtainable.

Stern discusses the diagnosis and treatment of echinococcous disease of the lung. The literature concerning the X-ray treatment of this condition is reviewed at some length. The author believes that at the present time there is insufficient evidence to justify the X-ray treatment of echinococcous disease.

The effect of X-radiation on healthy skin is described by Schinz and Slotopolsky, of Zürich. This is a comprehensive presentation of the resulting histologic changes.

Schempp, of Tübingen, describes the radiation treatment of nasal polyps. Radium or X-rays may be used, but X-rays are preferred because of the uniform dosage. Frequently a combination of both is necessary.

The use of diathermy in gynecology is discussed by Schoenholz, of Düsseldorf. The physical and mechanical features of the various types of apparatus are described. The indications and contra-indications, together with the practical application of the method, are discussed at some length.

ARCHIVES DE L'INSTITUT DU RADIUM DE L'UNIVERSITE DE PARIS ET DE LA FONDATION CURIE. By CLAUDE REGAUD and A. LACASSAGNE. Vol. I, No. 1. Les Presses Universitaries de France, pages 133, price 25 francs.

The outstanding position of the Institut du Radium, of Paris, in the field of radiology is well known. This new publication emanates from the Institute and this, the first number, is devoted to a concise but systematic review and analysis of the histophysiologic effects of roentgen and radium rays on the normal tissues of the higher animals, by Professor Claude Régaud and his associate, A. Lacassagne.

The authors do not intend this as a general and exhaustive review of the subject, but, rather, as a detailed summary and analysis of the present state of our knowledge of the effects of roentgen and radium rays on different kinds of cells. Taking up systematically, as it does in separate chapters, the influence of quality and quantity radiation on cellular metabolism, the action of radiation on the skin, the testis and ovary, the blood and blood-forming organisms, the mucous membrane of the digestive tract, the glands of external and internal secretion, connective tissue, blood vessels, muscle, bone, and nerve tissue, and the organism as a whole, together with a well selected bibliography and well chosen illustrations, this work bids fair to be of great interest and importance to radiologists and others who may desire reliable information on these different questions. The treatment of the different subjects is judicious and sound, the printing and illustrations are excellent, and the work as a whole is a good example of what a scientific publication should be.

ABSTRACTS OF CURRENT LITERATURE

INDEX TO ABSTRACTS IN THIS ISSUE

Radiation Therapy of Cancer of the Uterus. D. den Hoed. Strahlentherapie, 1927, XXVII, 426.

This is a statistical paper based on the clinical experience of the Institute for Cancer Research in Amsterdam. The tables and computations must be looked up in the original. As to the technic employed, it appears that the combination of X-rays and radium is favored. The fields of entry for X-ray treatments of the pelvis must not be too large. Moderate doses give better results. Even inoperable cases may be cured, at least in a small percentage.

E. A. Pohle, M.D.

Blood Vessel Visualization. John B. Carnett and Sigmund S. Greenbaum. Jour. Am. Med. Assn., Dec. 10, 1927, LXXXIX, 2039.

Occasionally one is confronted with a problem of differentiating, in a patient with a chronic toe ulcer, a very early thromboangiitis obliterans from trophic or other disturbances. In this connection, visualization of the blood vessels by means of a proper opaque substance would probably enable one to make an early diagnosis with the ultimate view of treatment before severe vessel alteration precluded all hope of cure. Besides, such visualization ought to be helpful in various disturbances of the vessels, such as embolism, aneurysm, and gangrene, for determining the extent of the obliterative process.

After extensive experimental injections in rabbits and injections of smaller amounts in man, the authors have found that 6 c.c. of iodized oil may be injected into the femoral artery of the average man with perfect safety. They expose the common femoral artery and pass a small tape around it under local anesthesia with 0.5 per cent procaine hydrochloride. The leg is elevated to empty it of blood, and sufficient tension is made on the tape to shut off the femoral pulse during the time required to inject the artery and take the first series of roentgenograms. The incision is placed so as to expose the common femoral artery at its bifurcation. A syringe needle of 29 ga. is inserted through the wall of the common femoral artery at a point where it can be passed first into the deep femoral artery and later into the superficial femoral artery without the need of making a second puncture. The injection is made slowly with the result that the iodized oil is plainly shown by the roentgen ray as globules in the femoral artery. Farther down the globules coalesce and appear as a solid stream. Roentgenograms are made with the utmost promptness on completion of the injection. With the roentgen-ray plates in position beforehand and exposure made the instant injection is completed it commonly happens in the absence of obstruction that very little iodized oil is shown in the trunk of the deep and superficial femoral arteries. The collateral circulation of the common femoral artery is usually ample to carry iodized oil along very rapidly. A second series of films is made after three or five minutes. The first series of leg pictures, however, as a rule is better than the subsequent one. The terminal vessels of the foot are generally best shown in a five-minute exposure. After ten minutes very little iodized oil remains in the lower extremity and nowhere else can the oil be detected. With increasing experience the technic continues to undergo modification. A few accompanying roentgenograms give an idea of the results.

The communication is made solely with the view of demonstrating the fact that this means of vascular exploration must be regarded as harmless, particularly on the lower extremity. However, practical conclusions in regard to differential diagnosis of vascular conditions, or as a test of vascular capabilities, cannot yet be given.

Hans A. Jarre, M.D.

Regarding the Influence of Dust and Dirt, Accumulating under Ordinary Conditions, on the Transparency of Window Glass for Ultra-violet Rays. W. Hausmann and O. Krumpel. Strahlentherapie, 1927, XXVII, 386.

The spectral measurements undertaken on quartz and window glass covered with dust showed that the transparency for ultra-violet

light down to 2,300 Ångstroms is not decreased.

E. A. POHLE, M.D.

Permanent Results in Cases of Carcinoma of the Female Generative Organs Following Radiation Therapy. Felix Gál. Strahlentherapie, 1927, XXVII, 27.

The author presents, in statistical form, the results of his clinic (University of Budapest) regarding the treatment of uterine carcinoma. He believes that all operable cases should go to the surgeon and the remainder to the radiologist. A combined treatment of X-ray and radium is advisable. In view of the extensive material on which this article is based, the tabulated results are reprinted here.

E. A. POHLE, M.D.

Ultra-violet Measurements with Cadmium Cell and Electrometer. A. Rüttenauer. Strahlentherapie, 1928, XXVII, 794.

Dorno has recommended the use of the cadmium cell in uviol glass for intensity measurements of the mercury vapor lamp. He has shown that the erythema curve of the human skin runs almost parallel to the sensitivity curve of the cadmium cell. The author has studied this relation again and comes to the following conclusions: Sensitivity measurements with the quartz cadmium cell and several filters (uviol glass, vita glass) demonstrate that it is not possible to match exactly cell

Cured	Less than 2 yrs.	2 yrs.	3 yrs.	4 yrs.	5 yrs.	6 yrs.	7 yrs.	Still living: Without recurrence	Still living: With recurrence	Total
Portio-carcinoma:										
Operable	2(+2)	1			1		1	2	1	5
Borderline	10(+6)	9(+1)	3	3	2	1		15	6	28
Inoperable	132(+92)	24(+15)	6	8	3	5	1	39	34	180
Post-operative recurrent	9(+9)		2(+1)	1	3			3	2	15
Corpus-carcinoma	23(+2)	3	4	7	6	2		35	8	45
Uterine carcinoma	33(+23)	2(+1)	1		1			5	8	37
Total	210(+134)	39(+17)	16(+1)	19	16	8	2	99	59	310
					26					
Operated on								138		
Not traced								85		
Cured	42(+21)	8(+2)	5(+1)	10	14	4	2	43	8	85
					20					

sensitivity and erythema curve. Comparative measurements with a cadmium cell can be used in therapy only for a source of ultra-violet rays changing in its absolute intensity but not in its spectral energy distribution. If different sources of ultra-violet rays are being compared, it is necessary to include in the publication of such results the cell sensitivity curve and the spectral energy distribution.

E. A. POHLE, M.D.

Local Lichen Planus Caused by X-raying a Lichen Planus Patient. Axel Cedercreutz. Urologic and Cutaneous Review, January, 1928, XXXII, 10.

A number of dermatologists have reported some very good results in lichen planus following irradiation as proposed by Pautrier. The author has also had some good results in some and failure in others. He reports a case of a woman 74 years of age who had patches of lichen planus on the hands, feet, and mucosa of the mouth. Ten days after treatment there was a marked improvement as to the patches on the hands and feet; but at this time she had patches of lichen planus on the back at the site of the X-ray treatment.

ROBERT A. ARENS, M.D.

Observations on Radiation Therapy in Connection with Glucose Injections. E. Mühlmann. Strahlentherapie, 1927, XXVII, 306.

A number of clinics in Vienna have published favorable reports regarding the combination of radiation therapy of malignant tumors with the intravenous injection of glucose. The author has tried this method on 22 cases suffering from malignant disease. Both X-rays and radium were used. Before each application 3.3 grams and later 4.5 grams glucose dissolved in 10 c.c. of water were injected. Following the exposure no increased erythema reaction of the skin was observed. Except in one case of carcinoma of the cervix and one case of carcinoma of the tonsils, with metastasis, which responded remarkably well, no beneficial influence of the combined treatment was noted. It appeared, however, that very few cases of X-ray sickness occurred; even if the patient showed nausea and vomiting, this was easily relieved by further glucose injections. A specific effect on the malignant tumor is rather improbable.

E. A. POHLE, M.D.

Investigations Regarding the Modification of Erythema and Pigmentation by External Factors. R. Stahl and G. Simsch. Strahlentherapie, 1927, XXVII, 311.

The authors studied the effect of a number of stimuli on the erythema and pigmentation formation following an exposure to the spectrum of a mercury vapor lamp. They came to the following conclusions: Local procedures carried out before the treatment influenced the degree of erythema and pigmentation. Certain observations pointed to the degree of filling of the blood vessels as the most important factor. Short hot arm baths which had caused a deep reddening of the skin increased the erythema following the light exposure; hot and cold baths of long duration, exposure to hot air, and stasis had a similar effect; short cold arm baths which had led to an ischemia decreased the degree of erythema. The pigmentation runs parallel to the degree of erythema but only within certain limits; for instance, cold baths were followed by a relatively much deeper pigmentation as compared with the increase in erythema. It is probable that a sensitization explains the observed reactions.

E. A. POHLE, M.D.

Roentgentherapy of Acne, Eczema, and Dermomycosis. Orville B. Chandler. Urologic and Cutaneous Review, January, 1928, XXXII, 25.

Acne: The author uses 90 K.V., 5 ma., 12 inch S.T.D. and 2 minutes to each body area and repeats in 10 days. Most cases show improvement after the third exposure. He

reports 16 cases, all but one of which became perfectly normal.

Eczema: The author used the same technic as above. In 41 cases there was not one of increased inflammation following treatment and in all there was a general clearing of the skin. The number of treatments varied from two to sixteen, the average being six. Improvements were noted at the end of one week in 7; end of two weeks in 18; three weeks in 10; end of four weeks in 4, and at the end of two months in 1.

Fungus Disease: Technic—90 K.V., 5 ma., 12 inch S.T.D., 5 minutes, no filter. This is an epilation dose and was ample except in small areas where one-half the dose was repeated in six weeks. Eight cases out of twelve were cured. The other four cases have shown a more intractable course.

ROBERT A. ARENS, M.D.

Regarding the Therapeutic Interruption of Pregnancy by Roentgen Rays. Walter Fürst. Strahlentherapie, 1927, XXVII, 496.

The use of roentgen rays in interrupting a pregnancy has been suggested by Ganzoni-Widmer. This procedure is severely criticized by the author and its dangers are discussed in detail. In his opinion there are extremely few cases where an operation is so strictly contraindicated that roentgen rays should be given a trial.

E. A. POHLE, M.D.

Silicosis as an Industrial Hazard in Ontario Gold Mining. Omer G. Hague and R. W. McBain. Am. Jour. Roentgenol. and Rad. Ther., October, 1927, XVIII, 315.

The authors have made a survey of the silicosis industrial hazards in gold mining in Ontario by clinical and roentgenological examinations of 4,000 miners. All of the cases were classified after X-ray study, as had been previously done by the Miners' Phthisis Bureau of South Africa, into: average normal chest, ante-primary stage silicosis, primary stage silicosis, or secondary stage silicosis. Patients with tubercle infection superimposed upon silicosis, no matter how limited the extent of the latter condition, were arbitrarily classified as secondary silicosis cases. Experience has shown that silicosis, uncomplicated, has a good prognosis except for mechanical restriction of lung function, whereas with tuberculosis complicating silicosis the prognosis is very grave.

According to the classification, ante-primary stage silicosis shows on the X-ray films a fine fluffy mottling, the shadows being pin-head to match-head in size, with the sites of predilection being outward from the lower bronchi, immediately beneath the pectoral muscles, and in the lower portions of the upper lobes.

Primary stage silicosis shows a beginning coalescence of the snow-flake mottling into clusters, but without mass formation. The changes here are scattered pretty much throughout both lung fields.

Secondary silicosis may be best described as simulating a miliary tuberculosis with all of the shadows greatly exaggerated and apparently fibrosed. However, the clinical and physical findings quickly rule out miliary tuberculosis and point to a secondary silicosis.

The authors emphasize that the roentgen findings and classification do not serve as a basis for determining compensation, since certain miners with very slight roentgen evidence show marked physical disability, and *vice versa;* therefore the roentgen findings are always closely correlated with the history and physical findings in determining compensation awards.

J. E. HABBE, M.D.

New Investigations Regarding the Pathogenesis and Therapy of Radiation Sickness. F. Burgheim. Strahlentherapie, 1927, XXVII, 297.

It seems that following X-ray therapy the cholesterol content of the blood is decreased. The author has, therefore, developed a preparation, called "Colsil," containing 0.1 gram cholesterol per tablet with a slight addition of lecithin. He recommends the administration of two tablets immediately after the

treatment and then one tablet per hour. The results have been very gratifying. He discusses the possibility that systemic disturbances observed in X-ray workers are also probably due to decrease of the cholesterol content of the blood.

E. A. POHLE, M.D.

Roentgen Biology of the Normal and Diseased Skin. G. Miescher. Strahlentherapie, 1927, XXVII, 257.

This is a very interesting discussion of the effect of roentgen rays on the normal and diseased skin. It is warmly recommended for study in the original.

E. A. POHLE, M.D.

On the Effect of Roentgen Rays on Pure Cultures of Gonococci. Alfred Cohn and Max Levy-Dorn. Strahlentherapie, 1928, XXVII, 746.

Several strains of gonococci were exposed in culture to roentgen rays. In twelve experiments filtered irradiation (180 K.V., 0.6 Cu., 3 E.D., 20 cm. F.D.), in thirteen experiments unfiltered irradiation (same potential, 37 E.D.) was used. The cocci were highly resistant to irradiation except in two cases.

E. A. POHLE, M.D.

Congenital Abnormalities of the Urinary Tract in Childhood. Henry F. Helmholz. Jour. Am. Med. Assn., Dec. 3, 1927, LXXXIX, 1932.

Not so very rarely children with pyuria or hematuria or both, or with abdominal tumor, acute abdominal colic, or disturbed micturition are treated for many months and even years without a careful urologic examination, including cystoscopy and pyelography. Since the usual case of acute pyelitis tends toward spontaneous recovery, complete urologic examination of every chronic case should not be postponed unnecessarily. If chronic pyuria is present in addition to tumor, hematuria, or colic, cystoscopy and pyelography should be carried out immediately without preliminary treatment. Following such policies Helmholz detected an unusually large number of congenital abnormalities of the urinary tract in children, and could take measures to prevent the entire renal parenchyma from becoming destroyed because of continued urinary backpressure and infection.

HANS A. JARRE, M.D.

The Absolute Definition of the Roentgen Unit in the Roentgen Institute in Bonn. L. Grebe and O. Gaertner. Strahlentherapie, 1928, XXVII, 728.

This is a detailed description of the methods and apparatus used at the University of Bonn in establishing a standard for the roentgen unit.

E. A. POHLE, M.D.

Radiation Therapy of Uterine Fibroids. Paul Strassmann. Strahlentherapie, 1927, XXVII, 281.

The author reports in this article the results of radiation therapy in cases of uterine fibroid. It is based on 1,032 patients seen from 1918 to 1926. Five hundred three women were irradiated, 529 operated upon. Of the 503 cases treated by radiation, 396 could be followed up. Of these, 92.7 per cent were cured. Technic of treatment: 180 K.V., 2 ma., 0.5 Cu. plus 1.0 Al., 30 cm. F.S.D., 34 per cent of the skin unit dose to each ovary, size of field 8×10 cm. A percentage of the cases (7.3 per cent) had to be operated upon later; 17 developed submucous fibroids, 4 ovarian tumors, 3 degenerated fibroids, 2 necrotic fibroids, 1 lymphatic fibroid, and 1 adenomyoma. The mortality among the treated patients was zero; of the cases operated on, 3.6 per cent died.

The author concludes that radiation and surgery should not be considered in a competitive sense. Radiotherapy is the method of choice if there is no strict indication for im-

mediate operation; only then, and if radiotherapy fails, surgical intervention is justified.

E. A. POHLE, M.D.

The Radium Treatment of Extensive Hemangiomas in Infants. Sanford Withers and John R. Ranson. Am. Jour. Roentgenol. and Rad. Ther., October, 1927, XVIII, 326.

Any radiotherapist having had past experience with the slow results obtained by repeated applications of radium packs to bulky hemangiomas with long intervals between treatments to prevent undue scarring, will welcome the method suggested in this article as a decided improvement, if the authors' excellent results can be duplicated.

The plan suggested is to implant radon seeds of low content (about 0.2 to 0.3 mc. content) into the tumor, allowing one implant per cubic centimeter of tissue, and immediately after implantation to apply a compression bandage over the growth to partially collapse the blood spaces. The prompt and excellent results with a single treatment according to this plan are ascribed to the biologic effects of the beta rays in producing an endarteritis and fibrosis of the vessels.

J. E. HABBE, M.D.

Rare Hair Pigmentation Following X-ray Treatment. P. Rostock. Strahlentherapie, 1928, XXVII, 800.

The author relates the history of a man thirty-two years old who received deep X-ray therapy for brain tumor in the left hemisphere (centrum semiovale) between June 25, 1925, and September 26, 1925. One and one-half E.D. was given to the left side field, 2 E.D. to the right side field, and 2 E.D. to the posterior field. There was a complete epilation of all treated areas. Before the first treatment the patient already showed baldness in the center of the head. In February, 1926, he returned, and, while the right side and posterior fields showed normal growth of hair, the hair over the left area was much darker and in contrast to the blond color of the rest of the hair. No explanation can be offered at present for this peculiar observation.

E. A. POHLE, M.D.

On the Light Sensitization in the Ultraviolet Spectrum. H. C. A. Lassen. Strahlentherapie, 1928, XXVII, 757.

Hematoporphyrin in solution of 1 : 10,000 sensitizes paramecia to ultra-violet rays in the region of 3,660 to 3,130 Ångstroms and 2,530 to 2,200 Ångstroms. Two biological maximal points are found for the organism; one at 2,800, one at 2,270 to 2,200 Ångstroms. The hematoporphyrin sensitizes in the region of its maximal absorption for ultra-violet rays.

E. A. POHLE, M.D.

Advanced Cancer—Experiences in its Treatment with Colloidal Lead. Albert Soiland, William E. Costolow, and Orville N. Meland. Calif. and Western Med., February, 1928, p. 198.

Because of the newness of the treatment, as well as the toxicity of lead, the authors have been somewhat hesitant in suggesting its use in any except advanced cases in which other therapy seemed to be hopeless. Most of the patients had had previous treatment. The first preparation used was the pure lead in colloidal form, but, later, the colloidal lead phosphate has been used because it is less toxic. Judging from the severity of the reactions which are observed, it is obvious that the method is dangerous. With the use of the colloidal lead phosphate, the authors have obviated many of the reactions.

To the time of writing they had treated 18 cases, only one of which can be looked upon as an arrested case. In looking over the records, the one impressive feature of the work carried on is the fact that, in order to get results with the use of lead itself, it must be pushed to the limit. Those individuals having a marked general reaction and some local reaction show improvement. When the dosage is divided so as to prevent acute constitutional effects, the lead is accumulative and does not seem to produce any clinical change in the

malignant tissues. When the more stable and less toxic colloidal lead phosphate is used, the effect on the growth is very slow. The treatment has considerable merit, but will require more observation and experience to gauge correctly the dosage that will give the maximum benefit.

F. B. SHELDON, M.D.

The Importance of Exact Anatomical Measurements in Roentgen Therapy. G. H. Schneider. Strahlentherapie, 1928, XXVII, 751.

The importance of exact anatomical measurements, as, for instance, diameter of pelvis, surface-distance of prostate and ovary irradiation, is emphasized. The author describes a universal caliper which facilitates such measurements on the patient.

E. A. POHLE, M.D.

Physostigmine as an Aid in Gastro-intestinal Roentgen-ray Diagnosis. Max Ritvo and Soma Weiss. Am. Jour. Roentgenol. and Rad. Ther., October, 1927, XVIII, 301.

In this article the authors present their experimental work on dogs and cats and the results on 44 patients where physostigmine salicylate in optimum human doses of 1/25 grain was used to overcome gastrospasm and increase tonus and peristalsis in cases of definite or suspected gastric or duodenal pathology. Within five to twenty minutes after the administration of the drug, which it was found could be given orally with as good effect as subcutaneously, increased tonus and peristalsis were noted in the small bowel, followed shortly thereafter by similar changes in the large bowel, and, lastly, increased gastric activity. The average duration of increased gastric activity, after administration of the optimum dose of 1/25 grain, was slightly less than one half-hour, while the large and small bowel returned to normal after a somewhat longer interval of time. Motility was not abnormally increased with this dose of the drug so that the use of physostigmine in a given case does not interfere with the routine examination as regards the rate of evacuation of either the stomach or bowel. When larger doses of 1/17 grain were used, some of the patients suffered from headache, dizziness, nausea, and cramps, but it was found that these unpleasant symptoms could be easily counteracted by 1/150 to 1/50 grain of atropine sulphate given preferably subcutaneously. An important observation noted by the authors was the quick return of the entire gastro-intestinal tract to its own individual normal state immediately following the wearing-off of the physostigmine effects, without any residual "tired-out" manifestations or increased atony.

Indications for the administration of the drug in gastro-intestinal studies are: *in the case of the atonic, dilated stomach,* to demonstrate more positively its normalcy by increasing peristalsis and tone; *in gastric or duodenal ulcer cases,* in order to better visualize and localize the lesion; *in gastric cancer cases,* to be more certain as to the exact extent of infiltration, and *in cases where organic gastric pathology can only be suspected* without the use of the drug but after its administration can be definitely proven. Contra-indications are: inflammatory processes, as appendicitis or peritonitis, severe cardiac disease, pregnancy, and intestinal obstruction.

J. E. HABBE, M.D.

The Absolute Measurement of the R-unit with the Large Standardization Instrument. Hans Küstner. Strahlentherapie, 1927, XXVII, 331.

This is a description of the procedure permitting the absolute measurement of the *R*-unit with the well known standardization instrument constructed by the author.

E. A. POHLE, M.D.

Radiation and "Automatin" in the Double Heart Experiment. H. Zwaardemaker. Strahlentherapie, 1927, XXVII, 413.

In previous publications the author has shown that surviving hearts stop beating after the potassium ions have been washed out. Pulsation may be started again under the in-

fluence of alpha and beta rays of radium. It seems that a chemical substance called "Automatinogen" is activated by radiation and transformed into "Automatin." The activated molecules are taken up by the circulation and it is possible to start a second heart, connected to the first heart, pulsating again. The latent time is dependent partly upon the duration of the standstill period.

E. A. POHLE, M.D.

Deep X-ray Therapy of Basal Celled Epithelioma Involving Cartilage. H. Flecker. Urologic and Cutaneous Review, February, 1928, XXXII, 69.

Deep X-ray therapy has the advantage of surgery because of the non-destruction of healthy tissue, and because of the uniform distribution over the whole growth if the sensitiveness of the tumor has not been interfered with by previous treatment—X-ray or otherwise. The author uses a sub-erythema dose at 200 K.V. with 1 mm. Cu. filter and 1 mm. Al. at one application. Usually this is sufficient. In some cases it should be repeated two or three times. He then cites three cases with good results following deep therapy and two cases with poor results, these in patients who had been treated previously by superficial dosage.

ROBERT A. ARENS, M.D.

Is the Borderline Therapy Superior to the Present Superficial Therapy? H. Schreus. Strahlentherapie, 1927, XXVII, 511.

The therapeutic effects of roentgen rays of long wave length (9 K.V.) and of roentgen rays as used in dermatology (100 K.V.) were compared. It appeared that two-fifths to three-fifths H.E.D. of long waves were less effective than one-fourth to one-third H.E.D. of roentgen rays of medium penetration. In many cases the treated skin showed a long lasting pigmentation when long waves were used. Absorption measurements lead to the opinion that the basal layer of the skin is not more protected when administering rays of long wave length. There seems to be no difference in the mechanism of effect between rays produced at 9 K.V. and 100 K.V. Photochemical tests convinced the author that the so-called borderline rays are closer to roentgen rays than to ultra-violet rays.

E. A. POHLE, M.D.

On the Biology of Ultra-violet Light. (Fourth Communication. The Reaction of the Human Skin to Repeated Exposure with Ultra-violet Rays—Light Protection.) L. Schall and H. J. Alius. Strahlentherapie, 1928, XXVII, 769.

The reaction of the skin to ultra-violet rays from a mercury vapor lamp (unfiltered and filtered through window glass) was studied with a tintometer which permitted the grading of the erythema and pigmentation. In the majority of cases there is less reddening in a previously exposed area. This "protection" lasts up to fifty days. It is not necessarily related to pigmentation because there were patients who developed no tanning at all but were definitely desensitized. On the other hand, some cases responded just as much to a second treatment if the first exposure had been followed by a good tanning. One single heavy dose affords better protection than a number of fractional doses. While there seems to exist no definite relation between this observed effect and the wave length in the ultra-violet region, a specific effect has been noted for ultra-violet rays and roentgen rays. There is no doubt but that they enhance each other, at least as shown by the skin reaction. If a large area of the body had been previously exposed, the erythema following irradiation of small areas with graded doses on a different part of the body would be definitely increased in 76 per cent of the studied cases. It is suggested that not the pigment but perhaps some proteins of the skin serve as "protecting" substances.

E. A. POHLE, M.D.

Investigations Regarding the Effect of Graded Doses of Roentgen Rays of Different Wave Lengths on the Structure and Function of the Ovaries. P. Schugt. Strahlentherapie, 1928, XXVII, 603.

Following a critical review of the literature the author relates the results of his investigations as to the effect of roentgen rays on the ovary. White mice were exposed to two types of radiation: 180 K.V., 0.5 Cu. plus 3.0 Al. and 100 K.V., 1.0 Al. Histological and functional studies of the treated animals up to seven months following irradiation led to the following conclusions: The castration dose for the white mouse is 54 *R* for hard rays and 42 *R* for soft rays. After doses as far down as 21 *R* the number of follicles was decreased. Four and a half months following the treatment all follicles including primary follicles were affected in the same way. Up to seven months following the application of a castration dose or as high as 140 *R*, one finds in the ovaries follicle epithelium, corpus luteum tissue, and germinative epithelium. There were also changes in the interstitial tissue in the ovaries of the sterilized mice, as often described before. No difference in the function of the ovaries treated with hard and soft rays could be detected. The estrual cycle does not disappear after treatment with castration dose or more up to 140 *R*. Its presence could be proved after seven months in eleven of nineteen animals examined, and after four and a half months in all of forty-five animals examined. It is possible to destroy by irradiation the external secretion of the ovary, namely the ovulation, while the inner secretion controlling the estrum remains intact. It was impossible to destroy the latter with doses up to two and a half times the castration dose, the animals being observed over a period of six months.

E. A. Pohle, M.D.

The Experimental Basis of Radium Therapy in Cancer. Prof. S. Russ. Lancet, May 5, 1928, CCXIV, 903.

The rays from radium and other radioactive bodies are now universally looked upon as definite therapeutic agents for cancer. There is no need for uncertainty about the measurement of radium as there is for X-ray. Dosage is usually expressed by quantity of radium and length of exposure, but it is essential to add a description of the applicators or tubes and to state exactly their position. Only when this is done can any comparison be made of the dose at different points in the tissues. (One wishes that those reporting results of radium therapy would not fail to remember this.) The effect varies with different tissues and the full effect is often delayed several weeks. There is no obvious destruction of tumor cells, but, rather, a slow change, resulting in their eventual disappearance. Time is, therefore, an essential factor in the series of events following radiation.

Animal tissues given a lethal dose show no change for from six to seven days, when some degenerative changes become noticeable. The well known selective action on embryonal type cells (glandular, lymphocytic, sex) is spoken of. The question whether the rays have a greater destructive action on malignant tissue than on normal can hardly be answered by a plain "yes" or "no." It may be answered in the future when accurate data are available.

A platinum tube 0.5 mm. thick (wall?) and 25 mm. long, containing 25 mg. of radium element, placed in the center of a rapidly growing rat tumor for 48 hours will result in a lethal dose to cells a little more than 1 cm. from the center of the tube. The result can be equally well obtained by 50 mg. for 24 hours or 5 mg. for 10 days, but which is the best therapeutically? Much careful clinical investigation is bringing us nearer the answer. Experiment shows that one cannot use very small intensities of radium and hope to get a lethal effect on malignant cells, for it appears that, as with other agents, tissues—normal or malignant—can withstand very small intensities more or less indefinitely, if a certain definite intensity of action is not exceeded. This limiting intensity obviously sets a boundary to the useful range of radium tubes. Tubes are surrounded by three zones, a lethal, a growth-retarding, and a zone where the cells can resist the irradiation, even when prolonged

more or less indefinitely. The range of effect of any applicator or tube is rarely as much as 2.5 cm. through tissue; therefore, the radium should be distributed in as many foci as practicable, rather than concentrated in one spot.

The author does not think that there is much evidence for the belief that small doses actually stimulate growth of malignant tissue. The clinical observation that growth is occasionally more rapid after radium has been used in a septic growth can be better explained by the sepsis and necrosis than by the direct action of weak doses upon the proliferative power of the cell. We have no definite experimental evidence that weak doses may bring quiescent cells into activity. Early experimental studies showed that some cells are more sensitive during division. In order to take advantage of this, exposures lasting a week or more are often used, and it is sometimes claimed that better results are obtained in this way. The author believes it risky to conclude that this is caused by an effect on a larger percentage of dividing cells, and suggests it is just as likely that the effect is due to the fact that growing cells are more affected by long continued weak intensities than by short strong ones.

It has been proved that repeated sub-lethal doses often result in increased resistance of the cells, therefore treatment must be planned so that the whole dose will be given within a reasonable time and not repeated indefinitely. The effect on tumors is partly due to the effect on surrounding normal tissues. There is experimental evidence that malignant cells do not grow so readily into regions of the body that have been irradiated. This effect is dependent on the dose given and more work is needed for definite data along this line.

There is very little evidence that tumor cells, absorbed after irradiation, have a deterring effect on metastasis. The experimental work on transplanted tumors does not apply to human cancer in this case, for it has not been found possible to effect metastasis in animals with spontaneous tumors by irradiating the primary growth. Some evidence shows, however, that, under certain conditions, extracts from irradiated tumors will actually stimulate the tumor growth. The author suggests that this may possibly explain some of the bad results of radium therapy.

The best explanation of the effect of gamma radiation is that of ionization within the cells. This action is in all probability the one which, when the intensity is sufficient, at any rate starts processes which lead eventually to the damage of cells.

This article is a clear and concise compilation in abstract form of the action of radium on tissue, so far as it is known, and is well worth reading.

H. J. Ullmann, M.D.

Interpretation of Gastric Symptoms. Charles Bolton. Lancet, June 9, 1928, No. 5467, p. 1159; June 16, 1928, No. 5468, p. 1211.

The author, who is physician to the University College Hospital, of London, delivered this series of lectures before the Royal College of Physicians of London. On the basis of a study of some thousand cases of gastric disturbance, he discusses thoroughly the causes of the various dyspepsias. He offers a complete analysis of pain and the various discomforts resulting from organic and functional dyspepsias, giving the zones to which pain is commonly referred from parts of the esophagus and stomach.

M. J. Geyman, M.D.

Varicose Ulcers: A Comparison of Treatment by Ultra-violet Light and Unna's Paste Dressings. Dora C. Colebrook. Lancet, May 5, 1928, CCXIV, 904-907.

One group of patients was treated with either the air-cooled or water-cooled Hg quartz lamp, and the other by bandaging with muslin (foot and leg) in layers, each layer painted with a paste composed of zinc oxide 6, gelatin 4, glycerine 12, and water 16 parts, by weight. The paste was heated over a water bath and applied as hot as could be tolerated comfortably. No support other than that which the patient was in the habit of wearing was used in the light cases. There were 84 ulcers: 37 in the light group, and 47 in the

paste group. All cases were divided, likewise, into ambulatory and bed groups. Tracings were made of the ulcer outline from time to time for comparison. Tables accompany the paper, considering the patients in subgroups, with a discussion of each. Conclusions are that the rate of healing was markedly inferior under light therapy to that under paste, and this is the more noticeable in the ambulatory cases. Favorable changes of a general character were slight or absent in the irradiated ulcers, but occurred at an early stage in those dressed with the paste. Relief of symptoms was not obtained during light treatment, but was a marked feature of the paste cases.

This is a well presented report of careful observations, but it is problematical if it shows more than that ultra-violet will not produce healing in varicose ulcers when the exciting cause is present. It seems too much to expect, in the first place. The paste bandage acts to remove the cause—strain due to dilated, inelastic veins. A better test would have been to support all cases with bandages, and, for one group, add radiation. The effect on promotion of healing could then be observed under identical conditions. The condition under which the comparison is made is somewhat similar to a hypothetical test by immobilizing fractures in one group of cases and irradiating another group where no support is used (assuming that victims might be immune from pain), to determine if irradiation would accelerate union of the fractures.

H. J. ULLMANN, M.D.

Method for X-ray Examination of the Uterus: Preliminary Report. Lincoln Kallen. Northwest Med., February, 1928, p. 64.

This author, who is a "Lay X-ray Specialist," of San Francisco, describes a technic of securing radiographs of the uterus and adnexa by inflating the rectum and bladder with air, thereby securing the same effect as is given by pneumoperitoneum. He claims that no more discomfort is caused than is felt from a full enema. Bladder and rectum are inflated by a simple inflation bulb. Several excellent illustrations are shown, with the uterus, tubes, and ovaries well outlined.

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